

International Journal of Scientific and Research Publications

IJSRP, Volume 5, Issue 5

May 2015 Edition

ISSN 2250-3153

IJSRP

www.ijsrp.org

International Journal of Scientific and Research Publications

GENERAL INFORMATION:

IJSRP, International Journal of Scientific and Research Publications publish monthly journal under ISSN 2250-3153.

ONLINE VERSION

<http://www.ijsrp.org/e-journal.html>

ONLINE PRINT VERSION

<http://www.ijsrp.org/print-journal.html>

All the respective authors are the sole owner and responsible of published research and research papers are published after full consent of respective author or co-author(s).

For any discussion on research subject or research matter, the reader should directly contact to undersigned authors.

COPYRIGHT

Copyright©2015 IJSRP.ORG

All Rights Reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, scanning or otherwise, except as described below, without the permission in writing of the Publisher.

Copying of articles is not permitted except for personal and internal use, to the extent permitted by national copyright law, or under the terms of a license issued by the national Reproduction Rights Organization.

All the published research can be referenced by readers/scholars/researchers in their further research with proper citation given to original authors. Original author have all rights to print, distribute their published research.

DISCLAIMER

Statements and opinions expressed in the published papers are those of the individual contributors and not the statements and opinion of IJSRP. We assume no responsibility or liability for any damage or injury to persons or property arising out of the use of any materials, instructions, methods or ideas contained herein. We expressly disclaim any implied warranties of merchantability or fitness for a particular purpose. If expert assistance is required, the services of a competent professional person should be sought.

Contact Information:

Publication Head:

Dr. A. Jose Sagade

Mr. J. Prakash

Editor: editor@ijsrp.org

Website: <http://www.ijsrp.org>

Editorial Board: <http://ijsrp.org/editorial-board.html>

Table of Contents

Introduction to protocol discovery mechanism for secure elements applications.....1	
Sarabjeet Singh.....1	
Evaluation of prognosis in patients' with perforation peritonitis using Mannheim's peritonitis index.....4	
Dr. Tushar Dani, Prof. L. Ramachandra, Dr. Rajesh Nair, Dr. Digvijoy Sharma.....4	
Study of Lipoprotein a in Ischemic Stroke Patients39	
Dr. L. Muralidhar, M.D; Dr. D. Sridhar, M.D; Dr. G. Balaraju, M.D; Dr. Deepika, M.D.....39	
Power factor profile of NiO46	
Smita Jain, Dr. Purnima Swarup.....46	
Life and Diabetes49	
P.Thenmozhi.....49	
Improvement of the Enzymatic Performance of lipase from Pseudomonas sp. ADT3 via entrapment in alginate hydrogel beads55	
Arpita Dey, Tushar Kanti Maiti and Pranab Roy.....55	
Negative Pressure Wound Therapy versus Conventional Wound Therapy in Large Wounds64	
Sandhya Nagaraj, Ramesh Hosmani, Ravi Shankar J C.....64	
Prevalence of Cardiac Manifestations in HIV Infected Patients Correlating with CD4 Count74	
Dr. P. Shravan Kumar, M.D, Dr. R. Siddeswari, M.D, Dr. D. Sridhar, M.D, Dr. P. Shakuntala, M.D, Dr. Sitaram, M.D, Dr. S. Manohar, M.D.....74	
Effect of Pure and Modified Gum Arabic on the Mechanical Properties of Poly (Vinyl Chloride)78	
Sani I. Alhassan, Paul A. P. Mamza, Aliyu M. Ja'o and Udofia I. Asukwo.....78	
Ability of Gamma Radiation to Detoxify Black-necked Spitting Cobra (Naja Nigricollis) Snake Venom85	
Fatma Y. Abdou, Ezz El Din El Denshary, Esmat A. Shaaban and Marwa A. Mohamed.....85	
Collaboration Strategy in the Cross-Border Utilization of the springs of Senjoyo in the Border Area of the City of Salatiga and the Regency of Semarang, Indonesia95	
Hadi Wahyono, Achmad Djunaedi, Bakti Setiawan, Leksono Subanu.....95	
Survival Analysis of UIS patients under Parametric and Non-Parametric Approach using R software102	
Deepapriya. S and Ravanan. R.....102	
Subclinical Neck Nodes in early stages of Oral Tongue Cancer: Evaluation and Comparison with HPE106	
Dr. Ila Upadhyya, Dr. Mithun Jain.....106	
Analysis of Relative Humidity in Iraq for the Period 1951-2010114	
Abdulwahab H. Alobaidi.....114	
Evaluative Study of Internet Hate Groups and Role of Global Media123	
Dr. Ramesh Chandra Pathak.....123	

Synthesis, characterization and antitumour activity of Copper (II) complexes of some phosphonates	126
Ahmed I. Hanafy, Omar M. Ali, Zeinhom M. El-Bahy and Mohamed Mohamed Soliman.....	126
Analysis of Relative Humidity in Iraq for the Period 1951-2010	135
Abdulwahab H. Alobaidi.....	135
Eco-Friendly Management of Pulse Beetle, <i>Callosobruchus Chinensis</i> Linn. Using Botanicals on Stored Mungbean	144
Md. Zahid Khan, Md. Razzab Ali, Md. Serajul Islam Bhuiyan and Md. Awlad Hossain.....	144
Efficacy of Cognitive Behaviour Therapy for a Moderately Depressed Client: A Clinical Case Study	150
Angana Mukherjee.....	150
The Effect of Arsenic on Liver Tissue of Experimental Animals (Fishes and Mice) - A Review article	161
Kidanemariam Gaim, Girmay Gebru, Sunday Abba.....	161
Effect of Chemical Fertilizers on Dielectric Properties of Soils at Microwave Frequency	170
Vidya D. Ahire, D. V. Ahire and P. R. Chaudhari.....	170
Patient's Perception Regarding Nursing Care at Inpatient Department of Hospitals in Bhaktapur District	177
Sumitra Twayana, Ram Hari Adhikari.....	177
Effect of Corporate Wellbeing Practices On Employees' Performance among Commercial Banks in Kenya	180
Ben Bett Tuwai, Cyrus Kamau, Samson Kuria.....	180
Introduction to Mobile Ad Hoc Network	196
Ms. Amita Pandey.....	196
Questionnaire Survey: For Identifying Most Cost Influencing Parameter In Case Of Road Projects	202
Guruprasad Chavan, Amit Sharma, Ajay Kumar Nirala.....	202
An analysis of profitability position of private bank in India	211
Amit Kumar.....	211
Dynamics of soil organic carbon and soil texture in Marine National Park, Gujarat	222
Megha Bhatt, Ekta Patel and Y.T. Jasrai.....	222
Effects of Quality Management Systems on Performance of Kenya Ports Authority	227
Daniel Jonai Matata and Moses Kimani Wafula.....	227
Effects of Strategic Positioning of Service Delivery on Customer Satisfaction - A Case Study of FINA Bank	240
Asaph Ngetha Kamau, Moses Kimani Wafula.....	240

Antioxidative and antimicrobial activities of different solvent extracts of Moringa oleifera : an in vitro evaluation	255
Esayas Welday Tekle, N. P. Sahu, Makesh M.....	255
Discovery of Frequently Occurring Approximate sub sequences with distance	267
Ms. V. V. Kamble, Mr. S. V. Kamble.....	267
A review on Advanced Desktop computer	272
VivekchandKharwar, MukeshPatel, SunnyNahar.....	272
Patient Safety Culture across Hospital in South Sulawesi Province, Indonesia: Comparing Between Urban, Sub Urban and Rural Areas	276
Irwandy, Syahrir A.Pasinringi, Noer Bahry Noor, Annisa Faradina A, Andi Silviyah, Nurandini Pratiwi, Nurul Athifah A.....	276
Secured Data Outsourcing in Cloud Computin	280
Rajendra N. Kankrale, Mahendra B. Gawali.....	280
Application of Principles of Process Re Engineering for Improvement of Functional Flows of Dietary Services of a Tertiary Care Hospital	284
Dr Shashikant Sharma, Dr Sameer Mehrotra.....	284
Enhancement in AODV Protocol to Provide Best Path According to Signal Strength	290
Deepti Bansal, Megha vij.....	290
Physico-chemical characterization and kinetic study of methylene blue adsorption onto a Moroccan Bentonite	293
Ikram DAOU, Omar ZEGAOU, Rachid CHFAIRA, Hammou AHLAFI and Hamou MOUSSOUT.....	293
The Study on Slum Population and Improvement Programs of Slums in Punjab	302
Dr. Balwinder Kaur.....	302
An Approach to Detect and Correct Single Bit Data Error Using Reed_Muller Matrix	309
Monika Gope, Md. Ariful Islam Khandaker, Mehnuma Tabassum Omar.....	309
Drying characteristics of Orthodox broken type tea	314
K. Raveendran, A.D.U.S. Amarasinghe and W.S. Botheju.....	314
Association of Serum Uric Acid and Neuropathy in Pre-diabetic and Diabetic subjects in North Indian Population	323
Radhey Shyam, Pushalata Sachan, Munna Lal Patel, Shradha Singh and Sunita Tiwari.....	323
A Review of Agricultural Commodity Financialisation in India	330
Riju koruth and J. Mohamed Zeyavudheen.....	330
Solitary Rectal Ulcer Syndrome - The Masquerader	334
Odaiyappan Kannappan, Stanley Mathew, Ravikiran Naalla.....	334

Relationship between Homocysteine and Vitamin B9 Level in Male CHDPatients and Compare with Normal Healthy Male Subjects	339
Sharma Hemlata, Vyas Shalini, Dr. Vyas R.K.,Dr. chhaparwal Amit.....	339
Effect of mycorrhizae, NPK and compost on vegetative and reproductive parameters of soybean (Glycine max L)	342
Dahanayake Nilanthi and Alawathugoda CJ.....	342
Review of major abundant weeds of cultivation in Sri Lanka	347
Perera, P.C.D. and DahanayakeNilanthi.....	347
Ambush Marketing- A Study with Special Reference to Indian Premier League 2013	356
Ms. Rekha K.G.....	356
Fault Acknowledgement System for UPS using GSM	360
Aniruddha Dekate, Pradip Ramchaware.....	360
An Efficient K-Means Clustering by using Combination of Additive and Multiplicative Data Perturbation for Privacy Preserving Data Mining	364
Bhupendra Kumar Pandya, Umesh kumar Singh, Keerti Dixit.....	364
A Meta-Analysis of Cloud Computing Infrastructures Involving Cost regulation and QoS Requirements	368
Gokul.M, M.Tech, J.Caroline El Fiorenza.....	368
Power of Animated Characters: A study on how pictures of animated characters on packages of packaged food & beverages influence the product liking and preferences of children and perception of parents	371
Prof. (Dr.) Solanki Sandip P, Sheth Jaydeep H.....	371
Assessment on feature Affecting Customers Bank service Variety Decision Case of United Bank, Mekelle branch	381
Tewelde Fisahaye Meles.....	381
Live Video Streaming in Android Wearable Devices	388
Saminath.V.....	388
Identification and Classification of Rice varieties using Mahalanobis Distance by Computer Vision	394
Neelam, Jyoti Gupta.....	394
Intermolecular interactions identified with velocity of Ultrasound in Vanilin at different temperatures	400
B.S.Srikanth, Dr.S.Sekar,Dr.R.Ramasamy.....	400
Cost Adjustment of Fertilizer (Urea) Against Production Expenditure by Using Mathematical Methods of Operation Research Specific Linearity Control Bias-Slope Adjustment (OR-LSB)	404
Abdul Mannan, Nasir uddin Khan, Mushtaq Hussain, Sumaira Yousuf.....	404

Data Warehousing, Data Mining, OLAP and OLTP Technologies Are Indispensable Elements to Support Decision-Making Process in Industrial World	408
Amandeep Kour	408
Analysis of Causes of Physical Domestic Violence against Women in Huye District of Rwanda	415
Ntegereze Peter	415
Institutionalising Community Participation in Watershed Management: A Study of the Inchaban Watershed in the Western Region of Ghana	423
O, D, Mireku, P. K, Acheampong, S, Mariwah, K, Adu-Boahen, & A. K. Mensah	423
Design of Coax-Fed E-Shaped Microstrip Patch Antenna with Triple Bands	432
Muhammad Salim Garba	432
Mobilization Strategies for Effective Community Development Projects in Igbo-Etiti Local Government Area of Enugu State, Nigeria.	436
Ewelum, Johnson Nnadi (Ph.D), Mbara Kingsley Ugochukwu (Ph,D)	436
Cause of Land Degradation and Its Impacts on Livelihoods of the Population in Toke Kutaye Woreda, Ethiopia	440
Feyera Deresa, Tsetadirgachew Legesse	440
Hostel Facility Maintenance Preliminary Finding of Higher Education Institution in Malaysia	449
Yuseni Ab Wahab, Abd Samad Hasan Basari	449
Potential Use of Data Mining Techniques in Information Technology Consulting Operations	455
Mehran Qadri, Zubair Ahmad, Jamaludin Ibrahim	455
Economic Wealth Index: A tool to study the Economic Health of Districts of selected States in India	459
Anjum Ara Ahmad	459
Mental lexicon: A conceptual framework	468
Othman Aref Al-Dala'ien, Badri Abdulhakim D.M. Mudhsh, Ayman Hamid Al-Takhayinh	468
Pattern of Dyslipidemia in Diabetes Mellitus	472
Dr. Musa Khan, M.D., Dr. P. Sakuntala, M.D., Dr. R. Siddeswari, M.D., Dr. B. Sudarsi, M.D.	472
Realtime Epileptic Seizures Detection and Alert System Using NI Lab-View	478
M. Anil kumar, S. Kishore, N. Karthik, K. Chandra sekhar, Shaik Shafi, M.C.Chinnaiah	478
The Linkage between Career Growth, Work Engagement and Organizational Citizenship Behavior: An Insight	483
Farhana Hanim Mohsin	483
Detect and Prevent the Mobile Malware	487
Abdullah Mohammed Rashid & Ali Taha Al-Oqaily	487

Eco-Friendly Management of Pulse Beetle, <i>Callosobruchus Chinensis</i> Linn. Using Fumigants on Stored Mungbean	490
Md. Zahid Khan, Md. Razzab Ali, Md. Serajul Islam Bhuiyan and Md. Awlad Hossai.....	490
Sixth Sense Technology & Its Applications	496
Ranjeet Daroga, Nishantraj Pandey.....	496
Investigation and Comparative Study of Effect of Silica Fume in Cementitious Grouts	500
Dr. Shrikrishna A.Dhale.....	500
Relationship between Information and Communication Technology and Small Scale Industrial Units of Northern India	507
Ankit Garg, Ashima Garg.....	507
The Impact of Total Quality Management Using Data Mining on the Integrated Innovation Management in Smart Education	511
Ahmed I. El Seddawy, Mahmoud A. Ramadan, Ahmed S. El Rawas.....	511
Business' Students Industrial Training: Performance and Employment Opportunity	517
Erni bte Tanius.....	517
A Development Model Toward Social-Protection Policies for the Indonesian Women Migrant Contract Workers as Domestic Workers in Hong Kong	522
Hesti R.Wijaya, Keppi Sukesi, Henny Rosalinda.....	522
Effect of Drip Fertigation Pigeonpea Resultant Seed on Seed Storage	532
S. Manikandan and K. Sivasubramaniam.....	532
AT Commands	538
Meraj Alam.....	538
Buckling Analysis of Cold Formed Steel for Beams	543
Prakash M. Mohite, Aakash C. Karoo.....	543
Traditional knowledge of musical instruments used by the Bodo tribes of Northeast India, BTC, Assam.	550
Jahnovi Brahma, Tribeni Mandal, P. Gajurel, B. Singh & P. Rethy.....	550
A Comparative Study of Cardiovascular Parameters in Obese and Non-Obese Individuals	554
Dr.Ravikeerthy.M, Dr.Tejaswi Nataraj.....	554
The Role of Strategic Sourcing on Organization's Performance: A Case Study of Jomo Kenyatta University of Agriculture and Technology	558
Titus Wachira Kihanya, Moses Kimani Wafula, Evans Ojiambo Onditi, Ambrose Muriithi Munene.....	558
Effects of Internet Banking on the Financial Performance of Commercial Banks in Kenya a Case of Kenya Commercial Bank	569
Stephanie Kadzo Kombe and Moses Kimani Wafula.....	569

A Real Time Two Hand Gesture Recognition System Using Motion Static and Dynamic Image in British Sign Language	579
Pingale Prerna Rambhau, Prof.Rokade S.M.....	579
Post Exposure Passive Immunization with Purified Equine Rabies Immunoglobulin – Is Skin Sensitivity Test Needed?	585
Sunitha , A Madhav, Meera M.....	585
Securing NFC application data with combination of CLOUD (as SaaS Service) and secure element	589
Sarabjeet Singh.....	589
The knowledge management strategies used as a tool within and through strategic consulting firms to increase the organisational performance	592
Fatimetou Zahra Mohamed Mahmoud, Ahmed Mohamed Mahmoud , Jamaludin Ibrahim.....	592
Hemiogenesis of Thyroid Gland: A Case Report	597
Dr. Swapna A. Ambekar, Dr. Priya P. Wattamwar , Dr. Azhar A. Siddiqui & Dr. Hussain R. Zuberi.....	597
A Rare Case of Acromegaly Presenting with Cutis Vertics Gyrata	601
Dr. R. Nagamani, Dr. B.V.S. Ram Prasad, Dr. P. Shakuntala and Dr. B. V. S. Apoorva.....	601
A Prospective study of functional outcome after posterior cruciate retained total knee replacement	605
Pavan Kumar Reddy.K, T.H.Prakashappa, H.S.Chandrashekar, M.Ramasubba Reddy.....	605
Study on traditional worshiping plants in Hindu religion from Nalbari and Sonitpur districts of Assam	610
Jintu Sarma and Ashalata Devi.....	610
Laparoscopic versus open incisional hernia repair: An institutional experience	615
Dr. Vijay Koduru, Prof. Annappa Kudva, Dr. Ravikiran Naalla.....	615
Effects of Motivation Stress Factors on the Performance of Employees in Public Universities in Kenya	628
John Ng'ang'a Karihe, Professor G. S. Namusonge, Dr. Mike Iravo.....	628
Effects of Work Relationships' Stress Factors on the Performance of Employees in Public Universities in Kenya	653
John Ng'ang'a Karihe, Professor G. S. Namusonge, Dr. Mike Iravo.....	653
Effects of Working Facilities Stress Factors on the Performance of Employees in Public Universities in Kenya	676
John Ng'ang'a Karihe, Professor G. S. Namusonge, Dr. Mike Iravo.....	676
Role of Extended Producer Responsibility in context of electronic waste-Case of India	692
Anupam KHAJURIA.....	692

Effect of Seed Powder of Three Pepper Species on the Bionomics of Cowpea Bruchid, Callosobruchus maculatus Fabricius	695
Onekutu, A, Nwosu, L. C. and Nnolim, N. C.	695
4 – Element Spatial Power Combiner for High Frequency Communication Systems	700
M.H. Ali and S. Muhammad	700
Intrusion Detection System	709
Kashish Kukreja, Yugal Karamchandani, Niraj Khandelwal, Kajal Jewani	709
Effects of Problem-Based Learning in Teaching and Learning of Technical and Vocational Education and Training.	712
Sada, A. M, Mohd, Z. A., and Adnan, A. and Audu, R.	712
Azimuthal Resistivity Sounding with the Symmetric Schlumberger and the Alpha Wenner Arrays to study subsurface electrical anisotropy variation with depth	715
Van-Dycke Sarpong Asare, Emmanuel Gyasi, Bismark Fofie Okyere	715
Effect of dexmedetomidine with or without butorphanol on the clinico-physiological and haemodynamic stability in dogs undergoing ovariohysterectomy in midazolam and ketamine anaesthesia	727
Malik Abu Rafee, Prakash Kinjavdekar, Amarpal, H.P. Aithal	727
Fingerprint Recognition System for Matching	734
Manmeet Kaur Viridi	734
Future Generation Ultra Supercomputing 256×256 Bits Multiplier for Signed-Unsigned Number	739
Ravindra P Rajput, M. N Shanmukha Swamy	739
Synthesis and characterization of $Ba_{0.5} Sr_{0.5} (CO_{0.8}Fe_{0.2})_{1-x}Ti_xO_{3-\delta}$ (BSCF) Cathode for Solid Oxide Fuel Cell	745
D.Rama Krishna Sharma, DrP.VijayBhaskarRao	745
AUTOMATIC PAY AND PARK SYSTEM	755
Sushil Palande, Surekha Gangurde, Akshay Pote	755
Estimation of Caffeine in different brands of Energy drinks by Ultra-Violet Spectroscopy	759
Muhammad Mufakkar, Kalsoom Fatima, Huma Faheem, Shakeel Ahmad and Muhammad Hammad Khan	759
Nature of the Dogra State and the condition of the Muslims of Kashmir (1846 – 1930)	762
Showkat Ahmad Wani	762
Study on the Variation of Gaseous Pollutants at the city Jabalpur	770
Shampa Sarkar	770
Patient Waiting Time in Emergency Department	778
Sreekala P, Arpita Dan, Elizabeth M Varghese	778

A Review on Power Saving Techniques in MANET	781
A. Sakthi Saranya, G. Ravi.....	781
Big Data and a Smarter University: A Literature Review	785
Sameer Hayikader, Mohd. Toriq Khan bin Mohamad Niyaz Khan, Abdulrahman Dahlan.....	785
The Linkage between Training and Development and Co-Worker Support towards Employee Engagement in Hotel Industry	789
Pei-Yew Lai, Jee-Sin Lee, Yu-Xiang Lim, Ray-Gin Yeoh and Farhana Hanim Mohsin.....	789
Laser Induced Breakdown Spectroscopy for Identification & Quantification of Elemental Composition of Steel Structures: A Study of Early Stage Rust Behaviour in Steel	797
Osayuwamen Ogboghodo.....	797
An Analysis of the Effects of Inventory Management on the Performance of the Procurement Function of Sugar Manufacturing Companies in the Western Kenya Sugar Belt	809
Cynthia Mito Mukopi, Dr. Amuhaya Mike Iravo.....	809
Factors Influencing the Use of Alternative Methods of Procurement in Public Hospitals in Vihiga County	823
Laurine Muyuka Mukopi, Dr. Amuhaya Mike Iravo.....	823
Teacher motivation and job satisfaction on intention to quit: An empirical study in public second cycle schools in Tamale metropolis, Ghana	839
Isaac Kosi, Ibrahim Sulemana, Janet Serwah Boateng, Robert Mensah.....	839
Regeneration potential and distribution pattern of tree species along altitudinal gradient in Central Himalaya	847
J P Mehta, Shreshthamani and V P Bhatt.....	847
Water Quality Assessment of River Ganga Health Hazard Identification and Control	854
Singh Rajesh, Bahukhandi Kanchan, Mondal Prasanjeet, Singh Satendra.....	854
Awareness and Consequences of Human Immuno Deficiency Virus Disease among Undergraduate Students of University of Ilorin	862
Onifade, O. A, Ruth Adio-Moses, Ologele, I, Adigun, J. O, Ogungboye, R. O, Abikoye, A. I, Oguntunji, I. O.....	862
Photo-Induced Sodium salt of Partially Carboxymethylated Psyllium-g-Polyacrylonitrile: I. Synthesis and Characterization	869
Jignesh H. Trivedi, Wu Min, Young Huang and Harikrishna C. Trivedi.....	869
Photo-induced Sodium salt of Partially Carboxymethylated Psyllium-g-Polyacrylonitrile: II. Synthesis, Characterization and Swelling Behaviour of its Superabsorbent Hydrogel	879
Jignesh H. Trivedi, Wu Min, Young Huang and Harikrishna C. Trivedi.....	879

Introduction to protocol discovery mechanism for secure elements applications

Sarabjeet Singh

Research and Development, Syscom Corporation Limited

Abstract- Communication between Secure Elements and the Service providers have always been a matter of concern in terms of security for exchanging sensitive information in secure manner. Most common requirement for this information exchange is the protocols that are supported by different applications on secure elements or applications that interact with the secure elements. This paper describes how protocol discovery mechanism proposed by global platform works with SIM based applications (for example NFC application interacting with SIM and other applications) or application interacting with the cards to exchange information about supported protocols in the applications and provide/deny access to services based upon discovery of protocols.

Index Terms- SIM, Protocol, REST, OTA, Secure Element

I. INTRODUCTION

With evolution in GSM technology, use of secure elements have evolved from just storing information of user to performing interactions with outer world applications and exchanging sensitive data. Example of such interactions is NFC applications that interact with both secure elements via NFC controller installed on it and NFC terminals. For example, banking and payment applications are using SIM Cards to store information like passwords, card information, account information because SIM cards are considered as secure elements.

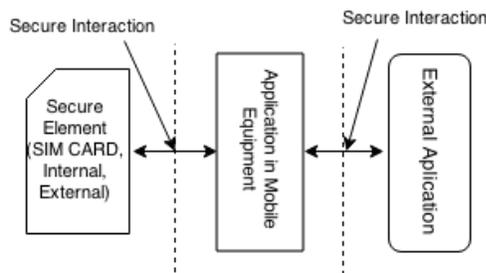


Figure 1: Simplified View of Interaction of application with secure element

A 'Secure Element' is tamper-proof entity that can be used to host applications securely. These elements can be of three types: embedded secure elements, universal integrated circuit cards a.k.a UICC or micro SD cards. Out of these three, micro SD and UICC are removable. These are not necessary to be a SIM card. A micro SD card or a security chip can also be used as a secure element. Which type of secure elements is to be used is dependent upon business needs because each element satisfies a

different market need. For example, for NFC applications on mobile equipments, UICC or SIM cards are used as secure elements.

Global Platform has defined specifications that allow different service providers to store different types of services on secure elements. A service can be defined as a composition of a set of applications to be deployed on the end user secure elements. This composition can optionally contain a User Interface application to be deployed in the device like Mobile equipment. This deployment is managed by using Over the Air Technology. This technology allows service providers to deploy, upgrade or remove applications and services on the secure elements. According to their requirements, these applications or services require communication with each other and exchange messages in a reliable and interoperable way. For example, for a bank, it has to request the deployment of a payment application in to an SE which has Over-The-Air (OTA) capability; for a Mobile Network Operator it may be required to notify the various life cycle events of the end-user mobile environment (device lost, etc.) to the service providers. Now, how these interactions are implemented are purely up to service providers implementations. But these interactions should be completely in compliance with Global Platform system messaging core specification. Since there are different protocols available in the market that can be implemented in the applications interacting with each other.

Research Elaboration – In order to complete a task, these applications need to communicate with each other and exchange messages in a reliable and interoperable way. There are cases when the interacting applications are supporting different protocols of communications or have different versions of same protocol implemented and applications needs to know about capabilities of each other to check which service should be loaded onto other. For such scenarios, these applications requires a method to exchange information of their capabilities and protocols to each other, this may be required only during first interaction. GP has introduced a new specification of protocol discovery mechanism between two interacting application based upon RESTful services consumptions (with exchange rules and format of protocol exchange). Currently a draft is released for public review.

With implementation of protocol discovery mechanism between applications following can be achieved:

- 1) Identification of protocol in client/server applications (client application must also support protocol discovery)
- 2) With identification, it can be found which protocols are supported by client/server application.
- 3) If client application does not support or implement required protocols for data exchange from/to the application

interacting with SE, access can be denied thus decreasing chances of unauthorized access to data on SE,

- 4) With protocol identification, the requesting application can know the protocols that it is not supporting (Client application may have updated protocol version that our application is not supporting), thus it can request the client application access based upon protocol that our application supports.

Use case examples:

First Case:

- 1) User mobile contains a web based application that interacts with SIM card present on mobile. It requires interaction with another application (say a website) for certain activities.
- 2) Application A (WEB application) required both X and Y to be checked for granting access.
- 3) User application discovers that application A requires X+Y protocol but it has only support for Y (The protocol information in extracted from secure element).
- 4) It can request Application A to grant access to services that requires only protocol Y (if Application A allows to do so)
- 5) In this way, user application will be able to use services of application A (not all but some, instead of denial of service usage)

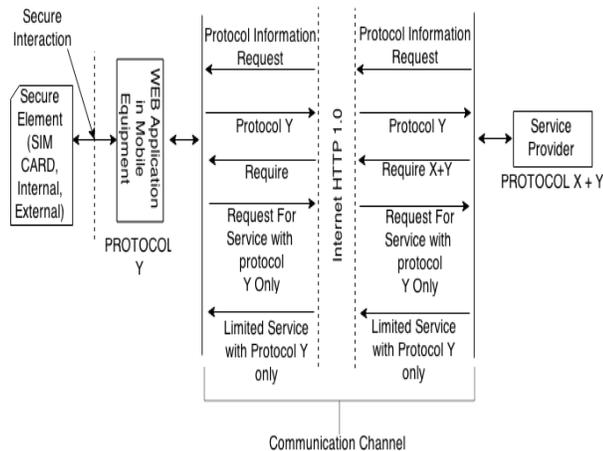


Figure 2: Protocol Discovery and Service request

One point to note here is that the request for service with only protocol Y is made by the Web application present on the Mobile equipment, not by the secure element. The web application when receives service, it is the responsibility of that application to load and manage the service on the secure element.

Second Case:

- 1) User has banking application that implements protocol X with version 1.1. It is interacting with application A that supports also supports protocol X. But the supported protocol version of communication in case of application A is 1.0
- 2) Application A requests banking application for its capabilities. Banking application publishes its capabilities to application A
- 3) Application A discovers that banking application have updated version of protocol X. It then undergoes upgrade of protocol X in itself.

- 4) In this scenario, Application A undergoes upgrade of its capabilities based upon capabilities of user application.

II. PROTOCOL EXCHANGE MECHANISM

The exchange of protocol information will happen with the help of HTTP REST Requests. GP System protocol discovery mechanism provides complete format and requirements for the request process, required REST URI formation, attributes and response exchange mechanism. An example of HTTP REST request for protocol information request is provided below:

**spdm/protocols?version=<version>&requesterId=<Discovering actor Id>
&secureComponentType={SE|TEE}&secureComponentId=<SC Id>**

Parameter information in the request URI:

Table 1: Parameter in HTTP REST request

Parameter	Information	Mandatory/Optional
Version	Version of the System Protocol Discovery Mechanism used by discovering application	Mandatory
requesterId	It is the identity of the Requester	Mandatory
secureComponentType	Type of secure component	Mandatory
secureComponentId	It is the identity of the secure component	Mandatory

Here secure components can be either secure element (SE) or Trusted Execution Environment (TEE).

Response Information: When a request for protocol/capability information will be received, the standard response of HTTP 200 OK code will be sent by the receiving entity with a response of required information. This response will be in standard JSON format that can be parsed by the requester application. The structure of the response will be pre-determined in accordance with the Protocol Discovery mechanism specification. Example of a standard JSON response for the request is provided below:

```
{
  "version": "<version>",
  "supportedVersions": ["<version #1>", "<version #2>"],
  "providerId": "<SPDM Provider Id>",
  "supportedProtocols": [
    {
      "protocolId": "<Protocol #1 Id>",
      "protocolVersion": "<Protocol #1 Version>",
      "protocolInfo": {
        "<Protocol #1 Info>"
      }
    }
  ],
  "referAlso": [
    {
      "additionalProviderURL": ""
    }
  ]
}
```

Response attributes are described in table 2 below:

Table 2: Response Parameter to be sent to requester application

Field	Information Provided by Field	Mandatory /Optional
version	Version of System Protocol Discovery Mechanism	Mandatory
supportedVersions	list of versions of System Protocol Discovery Mechanism protocol	Conditional
providerId	ID of Application providing security protocol discovery mechanism	Mandatory
supportedProtocols	List of supported protocols	Optional
protocolId	Protocol ID that might be used by requester for dialog exchange	Mandatory
protocolVersion	Version of identified protocol for dialog exchange	Mandatory
protocolInfo	Information specific to discovered protocol	Optional
referAlso	List of other applications present on secure element that can be contacted with the discovered protocol	Optional
additionalProviderURL	URL for additional application on which protocol discovery mechanism can be initiated by requester.	Mandatory

The identified protocols will be sent in format of MAJOR.MINOR.MAINTENANCE format.

For example, if a protocol has major version 1 minor and maintenance version as 0 then information in JSON field will be sent as: "1.0.0". For the URL to be formed, first requirement for the application is to get a base URL from the secure protocol

discovery mechanism. GP specification for protocol discovery mechanism has detailed information on how to get the base URL and form the request URLs for protocol discovery mechanism initiation.

III. CONCLUSION

With the emerging new applications in the field of secure elements, there soon will be requirement of a proper and common mechanism of information exchange and capabilities discovery between applications on secure application, application interacting with secure elements and applications that interact with applications that interact with secure elements. The discovery mechanism introduced and explained in this paper will allow the future applications an opportunity to work in collaboration with each other to provide versatile applications to users and increasing the use of secure elements for secure transactions and data storage

REFERENCES

- [1] GlobalPlatform System System Protocol Discovery Mechanism Specification(draft version)
- [2] GlobalPlatform Card Specification v2.2.1.
- [3] GlobalPlatform System – Messaging Specification for Management of Mobile-NFC Services v1.1.2.
- [4] 3GPP "Over the Air Technology" S3-030534
- [5] GSM 03.48: "Security mechanism for the SIM application toolkit.

AUTHORS

First Author – Sarabjeet Singh, Masters of Computer Applications, sarabjeet.singh2610@gmail.com.

Evaluation of prognosis in patients' with perforation peritonitis using Mannheim's peritonitis index

Dr. Tushar Dani¹, Prof. L. Ramachandra², Dr. Rajesh Nair³, Dr. Digvijoy Sharma⁴

Dept of General Surgery, Kasturba Medical College (KMC), Manipal University, Manipal

¹Dr. Tushar Dani MS (Assistant Professor) toshu2705@gmail.com

²Dr. Rajesh Nair MS (Senior Resident) rajeshnair39@yahoo.com

³Dr. Digvijoy Sharma MS (Assistant Professor) digz.sarma@yahoo.co.in

⁴Prof. L Ramachandra (Professor and Head) Department of Surgery

Abstract- Peritonitis is defined as inflammation of the serous membrane that lines the abdominal cavity and the organs contained therein. Most cases of peritonitis are caused by an invasion of the peritoneal cavity by bacteria, so that when the term peritonitis is used without specification bacterial peritonitis is implied. Peritonitis is one of the most common infections, and an important problem that a surgeon has to face.

Index Terms- Perforation peritonitis, Mannheims' peritonitis index, prognosis

I. INTRODUCTION

Despite the surgical treatment, sophisticated intensive care units, last generation antibiotics and a better understanding of pathophysiology, the mortality rate of perforation peritonitis are still high. The outcome of an abdominal infection depends on the complex interaction of many different factors and the success obtained with the early institution of specific therapeutic procedures. It also depends upon the exact recognition of the seriousness of the diseases and an accurate assessment and classification of the patients risks. Early prognostic evaluation of peritonitis is desirable to select high risk patients for more aggressive therapeutic procedure such as radical debridement, lavage system, open management and planned relaparotomy. An accurate risk index classification is the only way to settle a standard of comparison between group of patients and different treatment methods which would allow prospective adequate comparative studies.

There is no single, easily available laboratory test that predicts severity or prognosis in patients with peritonitis. Despite controversial discussion, there is agreement that prospective controlled clinical trials are necessary in the field of intra abdominal infections. Randomised controlled clinical trials are the preferred methods for comparing clinical efficacy of treatment strategies. They remain a vital bridge between advances in basic science on one hand and improvement in health care on the other. Therefore all measures should be undertaken to perform clinical trials with a high quality in this field. Many of the problems such as terminology and definitions, assessment of severity of disease, case selection, and exclusion of patients, confounding factors, end point, and generalised ability of a study result can be dealt adequately with the help of

scoring systems. Scoring systems have been advocated as prognostic predictors, they reduce all the clinical problems including lots of variables to a simple number¹.

Reproducible scoring system that allow a surgeon to determine the severity of intra-abdominal infections are essential to rectify the effectiveness of different treatment regimens, to scientifically compare surgical intensive care units, to select a more aggressive surgical approach for high risk patients and to able to inform patient's relatives with greater objectivity. The results of treatment for peritonitis are especially difficult to evaluate because these patients may correspond to various aetiologies, treatments differ and there is a lack of universally valid criteria and definitions. Identifying both prognostic factors and severity scales that provide objective description of the patient condition at specific points such as the preoperative and postoperative period is useful to improve our understanding of the problem involved¹.

Intra-abdominal infections and secondary peritonitis are a frequently encountered surgical emergency in tropical countries. The spectrum of perforation peritonitis in India continues to be different from its western counterparts. In India, the most commonly affected population is the young men in the prime of their life as compared to the west where the mean age for the occurrence of perforation peritonitis is usually 45-60 yrs. In majority of cases in tropical countries like India the presentation to the hospital is late with established generalized peritonitis with faecal or purulent contamination and varying degree of septicaemia. In India perforations of the proximal gastrointestinal tract were more common as compared to the distal ones.

Despite advances, mortality from many forms of intra-abdominal infection remains unacceptably high. Substantial differences between conventional & more recently developed therapy has been found in randomized prospective studies. It has become apparent that approaches for managing patient profoundly ill from intra-abdominal infection require further critical review at that new methods for analyzing the results of various therapeutic intervention must be found.

With this background an international congress on intra abdominal infection was organized in Hamburg in 1987, supported by the Surgical Infection Society (SIS) & the Paul Ehrlich society. Surgeons from all continents came to review the current status of definition as well as statistical techniques &

severity of illness scoring system, to allow for more sophisticated analysis of results.

The following classification of peritonitis is considered as a standard -

1. Primary Peritonitis

- A. Spontaneous peritonitis of childhood
- B. Spontaneous peritonitis of adults
- C. Peritonitis in patients with CAPD (continuous ambulatory peritoneal dialysis)
- D. Tubercular peritonitis

2. Secondary Peritonitis (Acute Suppurative)

A. Perforation peritonitis (spontaneous acute)

- 1. GIT perforation
- 2. Bowel wall necrosis
- 3. Pelviperitonitis
- 4. Peritonitis after translocation of bacteria

B. Postoperative Peritonitis

- 1. Leak of an anastomosis
- 2. Leak of suture line
- 3. Stump insufficiency.

Despite controversial discussion there is agreement that multicentre prospective controlled clinical trials are necessary in the field of intra-abdominal infection. Randomized controlled clinical trials are the preferred scientific methods for comparing the clinical efficacy of treatment strategy. They remain the vital bridge between advances in basic science on the one hand and improvement in health care on the other. Therefore all measure should be undertaken to perform clinical trials with a high quality in this field. Many of these problem areas such as terminology and definitions, assessment of severity of disease, case selection,

exclusion of patients, confounding factors, end points and generalizability of study results can be dealt with adequately with scoring systems. Clinical study in intra abdominal infection can be improved considerably by incorporation of scoring systems. Scoring systems assessing severity of disease can help to support comparison between results of different studies or centres².

Various scoring systems have been used to indicate prognosis of patients with peritonitis. These scores can be broadly divided into two groups:

A) Disease independent scores for evaluation of serious patients;

- APACHE II score
- simplified acute physiology score (SAPS II)
- sepsis severity score
- multiple organ dysfunction score

B) Peritonitis specific score;

- Mannheim Peritonitis Score (MPI)
- Peritonitis index altona II
- left colonic perforation score.

II. MANNHEIM PERITONITIS INDEX

It was developed by **Wacha and Linder**³ in 1983.

It was developed based on the retrospective analysis of data from 1253 patients with peritonitis in which 20 possible risk factors were considered. Of these 20 factors, only 8 were proved to be of prognostic relevance and were entered into **MANNHEIM PERITONITIS INDEX**. These factors were classified according to their predictive power.

MANNHEIM PERITONITIS INDEX SCORE

Study Variable	Adverse factor	Points	Favorable factor	Points
1.Age	>50 yrs	5	< 50 years	0
2.Sex	Female	5		0
3.Organ Failure	Present	7		0
4.Malignancy	Present	4		0
5.Evolution time	>24 hrs	4		0
6.Origin of sepsis	Non-colonic	4		0
7 Extension of peritonitis	Generalized	6		0
8.Character of exudate	Purulent Fecal	6 12	Clear	0

Maximal possible score is 47 and minimal possible score is zero. Patients were divided in three categories according to **MPI** score:

- 1. Score less than equal to 21
- 2. Score between 21 to 29
- 3. Score equal to greater than 29.

The MPI appears to be more practical than other scoring system, such as the APACHE II, which is time consuming and may be impossible to apply in the setting of intra-abdominal

sepsis. Also in a multicentre study of 2003 patients, the MPI had an acceptable specificity and sensitivity.

Much has been said and published about peritonitis but a consolidated analytical study of peritonitis and peritonitis grading scale is not found.

The secondary peritonitis being a common problem with a high mortality and morbidity rate made us interested in conducting the study. Gastric and duodenal perforations have been included in the present study.

No claim for originality can be advanced because similar works has been published, but if it can add a trifling bit to existing knowledge on this subject and its management, labour will be rewarded.

The present thesis is only a part of the project, in an attempt to fill up the gap mentioned earlier. The scope is indefinite and the greatest gain in research can come from its scope being indefinite. At the same time to the every inch that was there, there may be acres of waste.

In the end, we can only say that in the golden age of surgery, mortality from peritonitis is still a challenge to surgeon resplendent with brilliant achievements. Much has been learnt about the diagnosis and treatment of this catastrophe, but there is often more to learn. Still we should not be stressing the "What's new", until we have mastered the "What's old".

III. AIMS AND OBJECTIVES

1. To study the spectrum of perforation peritonitis.
2. To study the prognostic factors in perforation peritonitis.
3. To evaluate the outcome of patients with perforation peritonitis using **MANNHEIM PERITONITIS INDEX**.
4. To evaluate the **MANNHEIM PERITONITIS INDEX** to allow identification of high risk patients.
5. To confirm the predictive value of the **MANNHEIM PERITONITIS INDEX**.
6. To identify the patients using **MANNHEIM PERITONITIS INDEX** for intensive post-operative or ICU care.
7. Role of **MANNHEIM PERITONITIS INDEX** in decision making regarding surgical intervention in peritonitis.

IV. MATERIALS AND METHODS

STUDY DESIGN

"Evaluation of prognosis in patient's with peritonitis using Mannheim's peritonitis index" for approximate time period from 2009 to 2011.

SELECTION OF CASES

From cases attending our institute in which diagnosis of peritonitis is established by operative findings or surgical interventions during management. Therefore nonrandomized sampling technique was used.

INCLUSION CRITERIA

Cases of peritonitis secondary to hollow viscous perforation attending our institute in the study period were included in the study.

EXCLUSION CRITERIA

- Patients absconded or discharged against medical advice (DAMA) during hospital admission.
- All patients with primary peritonitis (Spontaneous bacterial peritonitis)

- All patients with tertiary peritonitis - Patients with peritonitis due to anastomotic dehiscence or leak
- Patients with acute appendicitis (without perforation)
- Diagnosis was made by a combination of history, clinical examination and on the basis of the reports of the radiological examinations after which the patients is posted for emergency laparotomy.
- Once the diagnosis of peritonitis was confirmed by the operative findings of the patients, the patients were accepted for the study.

The following parameters were recorded meticulously for the calculation of the Mannheim Peritonitis Index :

1. Age
2. Sex
3. Organ Failure
 - ❖ The criteria which were used for the presence of organ failure are as follows Published by *Deitch⁴ (1992)*:
 - **Renal failure:** serum creatinine >177mmol / L (> 2 mg/dl) or serum urea >16.7 mmol/L (>46.78 mg/dl) {conversion factor is 88.40 and 0.3570 respectively} or oliguria < 20 ml/ hour.
 - **Shock:** Hypotension is defined as a systolic BP of <90 mmHg or a reduction of >40 mmHg from baseline, in the absence of other causes for the fall in blood pressure.
 - **Intestinal obstruction** (only if profound): paralysis >24 hours or complete mechanical ileus.
 - **Respiratory failure:** pO₂ <50 mmHg or pCO₂ >50 mmHg.

4. Malignancy

Patients with known malignancy or with features of malignancy on gross examination e.g. malignant gastric perforations, perforation of a colonic growth suspicious of malignancy, perforation of proximal bowel due to distal obstruction by malignant growth on gross examination were included in the study.

5. Evolution time

Patients were divided into two groups (<24 hour / >24 hour) on the basis of history and timing of surgery.

6. Origin of sepsis (colonic / noncolonic)

This parameter is recorded on the basis of findings of laparotomy.

7. Extension of peritonitis (Diffuse/ localized)

8. Character of exudates or peritoneal fluid

- a) Clear
- b) Cloudy/purulent
- c) Faecal

Bilious collections in cases of recent perforation without superadded infection were grouped as clear. Serohaemorrhagic collection of recent origin is taken as clear in traumatic peritonitis.

The individual score of each parameter is added to calculate Mannheim peritonitis index score of each case. Patients were divided into three categories according to the score:

1. Score less than 21.
2. Score between 21 to 29.
3. Score more than 29.

V. REVIEW OF LITERATURE

HISTORICAL REVIEW^{5,6}

Peritonitis was recognized as a universal fatal condition from the earliest of times. Monographs and review articles on peritonitis are found almost exclusively in the surgical literature. An historical perspective of the slow unraveling of the pathology, microbiology, and evolution of the treatment is best appreciated in "The peritoneum" by Hertzler⁵ (1919), "Infections of the peritoneum" by Steinberg (1944), and reviews by Hedberg and Welch and Hauet al⁶. Kennedy (1951) found the incidence of perforation in carcinomatous ulcer to be at least 16.7 % of all gastric perforation and 5.4 % of all gastro-duodenal perforations.

The importance of correct diagnosis and treatment of gastroduodenal perforation is gradually increasing due to high incidence of mortality of 10-20% (Bryne) and gradual increase in the incidence of perforation every year.

Jamieson (1955) reported that the incidence of perforation increased three fold between 1924 and 1958.

Portis and Jaffo (1936) found the occurrence rate of perforation to be 14% of all ulcer patients.

The benign gastro-duodenal perforation is more common in the males than the females, the ratio being 10:1 (Bailey & Love). It is more common in winter than summer (Turner 1951). It is much less common in children than the adults and the clinical features are less dramatic than that in adults (Bell, 1953). Peptic ulcer complications are rare in pregnant women (Sandweiss et al, 1943). Commonly these perforations occur in the afternoon between 3 pm and 6 pm (Illingworth et al 1944, Jamieeson 1955).

ANATOMY OF PERITONEUM AND PERITONEAL CAVITY^{5,7-10}

The peritoneum is a continuous, glistening and slippery transparent serous membrane. It lines the abdominopelvic cavity and invests the viscera. The peritoneum consists of two continuous layers the: the parietal peritoneum, which lines the internal surface of the abdominopelvic wall, and the visceral peritoneum, which invests viscera such as stomach and intestines. Both layers of peritoneum consist of mesothelium, a layer of simple squamous epithelial cells.

The parietal peritoneum is served by the same blood and lymphatic vasculature and the same somatic nerve supply as is the region of the wall it lines. Like the overlying skin, the peritoneum lining the interior of the body wall is sensitive to pressure, pain, and heat and cold, and lacerations. Pain from the parietal peritoneum is generally well localized, except for the on the inferior surface of the central part of diaphragm, where innervations is provided by phrenic nerve, irritation here is often referred to the C3-C4 dermatomes over the shoulder.

The visceral peritoneum and the organs it covers are served by the same blood and lymphatic vasculature and visceral nerve supply. The visceral peritoneum is insensitive to touch, heat and cold, and lacerations; it is stimulated primarily by stretching and chemical irritation. The pain produced is poorly localized, being referred to dermatomes of spinal ganglia providing sensory fibres, particularly to midline portions of these dermatomes. Consequently, pain from the foregut derivatives is usually experienced in the epigastric region, that from midgut derivatives in the umbilical region, and that from hindgut derivatives in the pubic region.

The peritoneal cavity is within the abdominal cavity and continues inferiorly into pelvic cavity. The peritoneal cavity is a potential space of capillary thinness between the parietal and visceral layers of peritoneum. It contains no organs but contains a thin film of peritoneal fluid, which is composed of water, electrolytes, and other substances derived from interstitial fluid in adjacent tissues. Peritoneal fluid lubricates the peritoneal surfaces, enabling the viscera to move over each other without friction and allowing the movements of digestion. In addition to lubricating the surfaces of the viscera, the peritoneal fluid contains leukocytes and antibodies that resist infection.

Lymphatic vessels, particularly on the inferior surfaces of the diaphragm, absorb the peritoneal fluid. The peritoneal cavity is completely closed in males; however, there is a communication pathway in females to the exterior of the body through the uterine tubes, uterine cavity, and vagina. This communication constitutes a potential pathway of infection from exterior.

The peritoneal cavity is subdivided into interconnected compartments or spaces by 11 ligaments and mesenteries. The peritoneal ligament and mesenteries includes the coronary, gastrohepatic, hepatoduodenal, falciform, gastrocolic, duodenocolic, gastrosplenic, splenohepatic, and phrenocolic ligaments and the transverse mesocolon and small bowel mesentery.

These structures partition the abdomen into nine potential spaces viz.

1. Right subphrenic
2. Left subphrenic
3. Subhepatic
4. Supramesenteric
5. Inframesenteric
6. Right paracolic gutter
7. Left paracolic gutter
8. Pelvis
9. Lesser sac

This compartmentalization directs the circulation of fluid in the peritoneal cavity and thus may be useful in predicting the route of spread of infection and malignant diseases. For example; Perforation of the duodenum from peptic ulcer disease may result in the movement of the fluid (and the development of abscesses) in the subhepatic space, the right paracolic gutter and the pelvis.

FUNCTIONS OF PERITONIUUM

The peritoneal membrane provides lubrication for the loops of intestine by secreting a highly viscous fluid.

The mesothelial cells are also able to secrete lytic enzymes, prostaglandins, interferons and lymphokines some of which probably discourages infection.

PERITONEAL PHYSIOLOGY¹⁰

The peritoneum is a bidirectional, semi permeable membrane that controls the amount of fluid within the peritoneal cavity, promotes the sequestration and removal of bacteria from the peritoneal cavity, promotes the sequestration and removal of bacteria from the peritoneal cavity, and facilitates the migration of inflammatory cells from the microvasculature into the peritoneal cavity. Normally, the peritoneal cavity contains less than 100 ml of sterile serous fluid. Microvilli on the apical surface of the peritoneal mesothelium markedly increase the surface area and promote the rapid absorption of fluid from the peritoneal cavity into the lymphatics and the portal and systemic circulation. The amount of fluid within the peritoneal cavity may increase too many litres in various diseases such as cirrhosis, nephritic syndrome, and peritoneal carcinomatosis.

The circulation of fluid within the peritoneal cavity is driven in part by the movement of the diaphragm. Intercellular pores in the peritoneum covering the inferior surface of the diaphragm (termed stomata) communicate with lymphatic pools within the diaphragm. Lymph flows from these diaphragmatic lymphatic channels through sub pleural lymphatic to the regional lymph nodes and ultimately the thoracic duct. Relaxation of the diaphragm during exhalation opens the stomata, and the negative intra thoracic pressure draws fluid and particles, including bacteria, into the stomata. Contraction of the diaphragm during inhalation propels the lymph through the mediastinal lymphatic channels into the thoracic duct.

It is postulated that this so-called diaphragmatic pump drives the movement of peritoneal fluid in a cephalic direction towards the diaphragm and into the thoracic lymphatic vessels. This circulatory pattern of peritoneal fluid towards the diaphragm and into central lymphatic channel is consistent with the rapid appearance of sepsis in patients with generalized intra-abdominal infections as well as the perihepatitis of Fitz-Hugh-Curtis syndrome in patients with acute salpingitis.

The peritoneum and peritoneal cavity respond to infection in the following ways:

The bacteria are rapidly removed from the peritoneal cavity through the diaphragmatic stomata.

Peritoneal macrophages release pro inflammatory mediators that promote migration of the leukocytes into the peritoneal cavity from the surrounding microvasculature.

Degranulation of peritoneal mast cells releases histamine and other vasoactive products, causing local vasodilation and the extravasation of protein-rich fluid containing complement and immunoglobulins into the peritoneal space. Protein within the peritoneal fluid opsonises bacteria, which, along with activation of the complement cascade, promotes neutrophil and macrophage, mediated bacterial phagocytosis and destruction. Bacteria become sequestered within fibrin matrices, thereby promoting abscess formation and limiting the generalized spread of the infection.

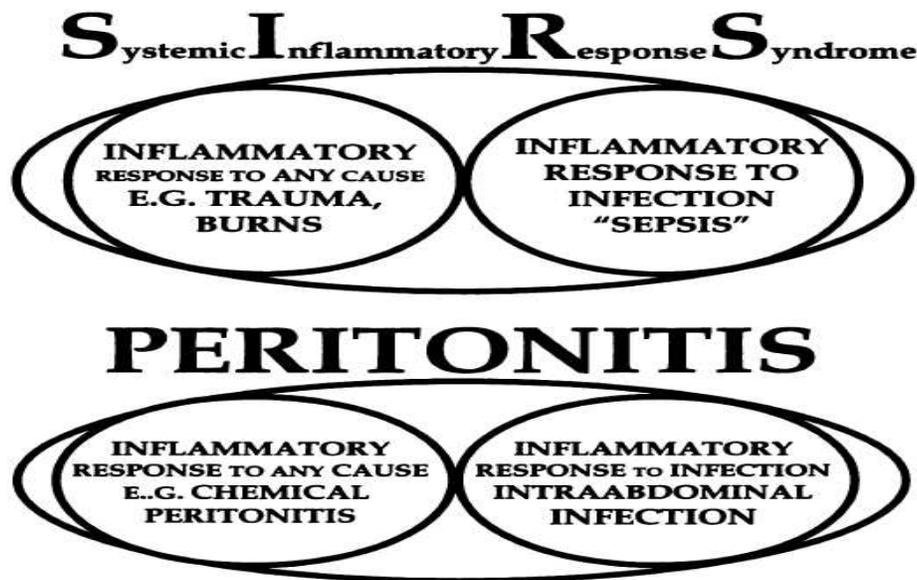
PATHOPHYSIOLOGY OF PERITONITIS^{7,10-13} CLASSIFICATION AND STRATIFICATION¹⁴

Definition

Peritonitis and intra-abdominal infection are not synonymous. Peritonitis denotes inflammation of the peritoneum from any cause. It may be regarded as the localized equivalent of the systemic inflammatory response seen after any trigger of inflammation, which recently has been described as systemic inflammatory response syndrome. Intra-abdominal infection denotes peritonitis caused by bacteria (e.g., a local inflammatory process initiated by bacteria and their toxins).

It may be regarded as the localized equivalent of systemic sepsis. Intra-abdominal abscess is an intra-abdominal infection that has been confined within the abdominal cavity. Because the vast majority of clinically significant peritonitis is caused by bacteria, both terms are used interchangeably. Intra-abdominal infection is defined as an inflammatory response of the peritoneum to micro-organisms and their toxins, which results in purulent exudates in the abdominal cavity.

Conditions without such peritoneal inflammatory response, in which contamination has occurred but infection is not established (e.g., early traumatic bowel perforation), or in which the infectious process remains contained within a diseased, but resectable organ (e.g. gallbladder or appendix), represent "simple" form of peritonitis, easily cured by an operation and not requiring prolonged additional antibiotic therapy.



Relation between SIRS & sepsis vs. Peritonitis & intraabdominal infection

Peritonitis results from any local trigger of inflammation. Usually infection is the trigger, although infection may not necessarily be present at the localized peritoneal space surrounding an infected but resectable intraabdominal organ, such as the appendix or gallbladder. In contrast, there may be contamination of the peritoneum from a defect in the intestinal wall, before establishment of infection or onset of an inflammatory response, e. g. immediately following penetrating abdominal trauma. Peritonitis has been categorized as primary, secondary, or more recently tertiary.

Primary peritonitis is an infection of the peritoneal cavity not directly related to other intra abdominal abnormalities. The vast majority of cases are due to bacterial infection; it is commonly known as spontaneous bacterial peritonitis (SBP). Usually it occurs in the presence of ascites. In the preantibiotic era, primary peritonitis accounted for ~ 10% of all paediatric abdominal emergencies; it now accounts for < 1-2%. The decline has been attributed to widespread use of antibiotic for minor upper respiratory tract illness.

The infrequency of primary peritonitis in form of ascites other than due to liver disease emphasizes the importance of intrahepatic shunting in the pathogenesis of the disease.

Secondary intraabdominal infection is usually due to spillage of gastrointestinal or genitourinary micro-organisms into the peritoneal space as a result of loss of integrity of the mucosal barrier. Examples include appendicitis, diverticulitis, cholecystitis, penetrating wound of bowel, and perforation of a gastric or duodenal ulcer. Secondary infection is relatively common; taking the form of either generalized or localized abscesses. Abscesses may be restricted to the immediate peritoneal space around a diseased intra abdominal organ, such as pericholecystic, periappendiceal, or peridiverticular abscesses, or to certain peritoneal recesses, such as interloopal, subdiaphragmatic, subhepatic, lesser sac or pelvic abscesses.

Tertiary peritonitis is conceived as a later stage in the disease, when clinical Peritonitis and systemic signs of sepsis (e.

g., fever, tachycardia, tachypnoea, hypotension, elevated cardiac index, low systemic vascular resistance, leucopenia or leukocytosis, and multiorgan failure) persists after treatment for secondary peritonitis and either organisms or low virulence pathogens, such as *enterococci* or *fungi*, are isolated from peritoneal exudates. This organism may gain access to the peritoneal cavity by contamination during operative Interventions, by selection from the initial polymicrobial peritoneal inoculum by antibiotic therapy, or by translocation of bowel flora. Translocation may be promoted by intestinal ischemia, endotoxemia, malnutrition, or proliferation of resistant bowel flora by antibiotic pressure.

Undoubtedly, many of the systemic as well as abdominal manifestation of the peritonitis are mediated by cytokines, such as TNF, IL-1, IL-6, IFN-gamma, and others.

Cytokines appear in the systemic circulation of patients with peritonitis and to a much greater extent in the peritoneal exudates. These cytokines are produced by macrophages and other host cells in response to bacteria or bacterial products, such as endotoxin, or by tissues traumatized during operative procedures. Another potential source is direct translocation of cytokines through the intestinal barrier.

With gastrointestinal perforation as the precipitating event, the number and type of micro-organism isolated from the peritoneal cavity depend on level of perforation. The stomach in fasting state contain sparse microflora of a few relatively more acid-resistant species, e. g., lactobacilli or candida species. Similarly, the duodenum and the proximal bowel contain a sparse microflora in the fasting state, whereas the colon contains a high microbial density, i.e., about 10^{12} per gram are obligate anaerobes, mainly of *bacteroides fragilis* group.

Gastric perforations are associated with either sterile chemical peritonitis or peritonitis due to above mentioned pathogens, depending on the underlying gastric condition. Similarly, the normal sparse flora of small bowel may be altered by gastric disease or small bowel ileus.

Peritonitis is thought to pass through three phases:-

PHASE 1- Involves rapid removal of contaminants from the peritoneal cavity into systemic circulation. The contaminated peritoneal fluid passes through stomata in the diaphragmatic peritoneum and is absorbed into lymphatic lacunae. The lymph flows into the main lymphatic duct through the substernal nodes. The resultant septicaemia predominantly involves Gram negative facultative anaerobes and is associated with high morbidity.

PHASE 2- Involves synergistic interaction between aerobes and anaerobes as they encounter host complement and phagocytes. The complement is activated by classical pathway, with the alternate and lectin pathway in support.

Phospholipids surfactant produced by the parietal mesothelial cells work synergistically with complement to increase opsonisation and phagocytosis. Peritoneal mesothelial cells are also potent secretors of proinflammatory mediators, therefore peritoneal mesothelial cells play a major role in the cell signaling pathway leading to recruitment of phagocytes to the peritoneal cavity and the upregulation of mast cells and fibroblast in the submesothelium.

PHASE 3- It is an attempt by host defences to localize infection mainly via production of fibrinous exudates that traps microbes within its matrix and promotes local phagocytic effectors mechanism. It also serves to promote development of abscesses.

Factors favouring localization of generalization of peritonitis –

Localization

- Fibrinous Exudates
- Anatomical compartmentalization of peritoneum
- Greater omentum (Adheres to inflamed peritoneum)

Generalization

- Sudden visceral perforation
- Violent peritonitis
- Virulent infecting organisms
- Injudicious handling
- Immunocompromized state.

MICROBIOLOGY OF PERITONITIS^{15,16}

Typically primary peritonitis is a mono microbial, aerobic infection. The presence of obligate anaerobes or a mixed flora, suggest secondary peritonitis. The later represents a polymicrobial infection, after a spontaneous or traumatic breach in a microorganism containing viscous or because of a postoperative breakdown of intestinal anastomosis.

The number and type of bacteria increases progressively down the GI tract. Proximally it contains a sparse aerobes (coliforms) and oral anaerobic flora ($<10^4$), with the stomach and duodenum normally sterile. However, disease of stomach (eg carcinoma, gastric outlet obstruction) or acid reducing drugs may results in its colonization. Distally the colon contains largest concentration of bacteria – in 1 gram of stool up to 10^{12} obligate anaerobes and 10^8 facultative anaerobes (formally aerobes). After a perforation of colon more than 400 different species invades the bacteria invades the peritoneal cavity. Only a few are involved in ensuing infection. Postoperative state, administration of systemic and luminal antibiotics and the invasive environment of the intensive care unit may drastically modify patients ecology resulting in colonization of foregut with peculiar microorganisms

(fungi, coagulase negative staphylococci and gram negative bacteria of low pathogenicity). These are the organisms that may be found in tertiary peritonitis in intensive care unit infection or in multiple organ failure.

MOLECULAR BASIS OF PERITONITIS

Topley N et al¹² in their study on macrophages and mesothelial cells in bacterial peritonitis examined the mechanism underlying cellular host defence in the peritoneal cavity. This study has established that the resident cell of the peritoneal cavity, the peritoneal macrophages (PM phi) and the mesothelial cells (HPMC) contribute to the initiation, amplification and resolution of peritoneal inflammation. Ex vivo measurements of intraperitoneal inflammatory mediators during peritonitis has elucidated the time course for the generation of proinflammatory, chemotactic and anti-inflammatory cytokines and have identified that their secretion occurs largely within the peritoneum .This study provide evidence that both PM phi and HPMC derived mediators are directly involved in controlling inflammation. It has been widely accepted that resident PM phi forms the first line of defence against peritoneal infection, a more contemporary view would suggest that the direct or indirect (via secreted proinflammatory cytokines) interactions between PM phi and HPMC cytokine synthesis .Once the inflammatory response is initiated, recent evidence suggest that mesothelial cells upon activation by PM phi derived interleukin I,TNF alpha & beta are capable of amplifying inflammation and generating signals (via the creation of a gradient of chemotactic cytokines, IL-8, MCP-1, RANTES) for the recruitment of leukocytes into the peritoneum. This process is also facilitate via the cytokine driven up-regulation of adhesion molecule expression (ICAM –I & VCAM-I) on HPMC. Much less is understood about the mechanism by which inflammation molecules (IL-6&IL1) by receptors by PM phi and HPMC may be important in this process.

The existence of a peritoneal cytokine network controlling inflammation is now well established within this the interaction of PM phi and HPMC appear to play a pivotal role in host response to peritoneal infection.

Wolfgang Sendt et al¹³ compare the degree of the inflammatory response of human peritoneum with the severity of peritonitis.

They concluded that the pattern of peritoneal inflammatory reaction is relatively uniform and does not correlate with the clinical grading of severity.

CLINICAL MANIFESTATIONS^{7, 8, 10}

The clinical manifestations of peritonitis are fluid shifts and metabolic disturbance. The heart rate and respiratory rate initially increase as a result of volumetric, intestinal, diaphragmatic, and pain reflexes. Metabolic acidosis and the increased secretion of aldosterone, antidiuretic hormone and catecholamines subsequently alter cardiac output and respiration.

Protein is broken down and hepatic glycogen is mobilized as the body enters a highly catabolic state. Paralytic ileus develops, leading to pro-found sequestration of fluid and loss of electrolytes and protein-rich exudate. Gross abdominal distension causes diaphragmatic elevation, with resultant atelectasis and pneumonia. Multiple-organ failure, coma and death will follow if peritonitis persists and fails to localize.

DIAGNOSIS / PRESENTATION :

Pain is the most common symptom and may be localized or diffuse; it is usually constant and of a sharp, pricking character. A visceral perforation causes a sudden, severe pain that is usually first appreciated in the area of the perforation, but may become more generalized as peritoneal contamination spreads. The pain will be referred to the ipsilateral shoulder tip if the diaphragmatic peritoneum is involved.

Anorexia, malaise, nausea and vomiting are common associated features. Constipation is usually present, unless a pelvic abscess develops (which can cause diarrhea)

EXAMINATION:

General: a patient with peritonitis is pale, drawn and anxious; the eyes are sunken because of dehydration. Regular observations will show signs of systemic inflammatory response syndrome or, at worst, septic shock, hypovolaemic shock or multiple-organ failure.

Abdomen: The patient will lie supine and relatively motionless with shallow respiratory excursions. The knees are flexed and drawn up in order to reduce tension in the abdominal wall. In diffuse peritonitis, spasm of the abdominal musculature will result in board like rigidity and failure of the abdomen to move with respiration.

Abdominal palpation exacerbates the pain and therefore should be undertaken carefully and gently. It will show tenderness, guarding and rebound tenderness; the site of maximum tenderness is usually related to the site of pathology. Guarding will initially be voluntary, before becoming an involuntary reflex as inflammation progresses.

Specific pathognomonic signs of disease may be clinically evident (e.g. Rovsing's sign in acute appendicitis).

Digital rectal examination will elicit anterior tenderness in pelvic peritonitis.

Auscultation will confirm increasing ileus as bowel sounds diminish and eventually cease.

INVESTIGATIONS^{7, 8, 10}

Peritonitis is mainly a clinical diagnosis and urgent laparotomy should not be delayed for unnecessary investigations. Blood tests are discussed below:

Full blood count will demonstrate leukocytosis.

Urea and electrolytes will confirm dehydration and acute renal failure; results are used to guide replacement of fluid and electrolytes.

Liver function tests and serum amylase – a high concentration of amylase in serum is diagnostic of acute pancreatitis, but a moderately elevated concentration can be caused by other intra abdominal catastrophes (e.g. perforated duodenal ulcer).

Arterial blood gas reflects a metabolic acidosis, often preceded by a low arterial carbon dioxide tension caused by hyperventilation.

Grouping and cross matching – laparotomy may be indicated and therefore cross matched blood will be required.

IMAGING :

Erect radiograph of the chest will show pneumoperitoneum in about 70–80% of visceral perforations. A left lateral decubitus radiograph of the abdomen is an alternative in those who are unable to sit up. A supine radiograph of the abdomen is less informative, but has a 'ground glass' appearance in cases of diffuse peritonitis.

Ultrasound may play a role in confirming or excluding specific diagnoses (e.g. subphrenic abscess).

Computerized Tomography (CT) is far more accurate in negative prediction than ultrasound, and has largely replaced blind, diagnostic laparotomy in the search for occult sepsis. The diagnostic accuracy of both ultrasound and CT has also been affirmed in clinically equivocal cases of acute appendicitis.

DIFFERENTIAL DIAGNOSIS:

Basal pneumonia, myocardial infarction, gastroenteritis, hepatitis and urinary tract infection may be misdiagnosed as peritonitis.

Other causes of severe abdominal pain (e.g. intestinal obstruction, ureteric or biliary colic) tend to cause restlessness.

MANAGEMENT:

Conservative-

Medical treatment is indicated if the:

Infection has localized (e.g. appendix mass)

- Cause of peritonitis does not require surgery (e.g. acute pancreatitis)
- Patient is not fit for general anaesthesia (e.g. elderly, moribund patient with severe co morbidity)
- Medical facilities are unable to support safe surgical management

The principal elements of medical treatment are fluid hydration (i.v.) and broad spectrum antibiotics. Supportive care should include early enteral feeding (in preference to total parenteral nutrition) for patients with complex abdominal sepsis in the ICU.

Immediate-

High-flow oxygen is vital for all shocked patients. Hypoxia can be monitored by pulse oximetry or measurement of arterial blood gases.

Fluid resuscitation is initially with crystalloids (i.v.), the volume being dependent on the degree of shock and dehydration. Electrolyte (especially potassium) replacement may be required. The patient should be catheterized in order to monitor the hourly output of urine. Monitoring of central venous pressure and the use of inotropes may be appropriate in severe sepsis or in patients with comorbidity.

Analgesia – opiate analgesia (i.v.) and an appropriate antiemetic will be required.

Antibiotics should be broad-spectrum, cover aerobes and anaerobes, and given intravenously. A third-generation cephalosporin and metronidazole is a common primary strategy. For patients who acquire peritonitis in hospital (e.g. anastomotic leak) or who require intensive care, second-line therapy with meropenem or a combination of piperacillin and tazobactam is advised. Antifungal therapy should also be considered to cover possible *Candida* species. Early and appropriate use of

antibiotics is a key to reducing mortality in patients with septic shock associated with peritonitis.

Nasogastric tube and aspiration alleviates vomiting and abdominal distension and reduces the risk of aspiration pneumonia.

Definitive-Surgery:

The prerequisite for the surgical treatment of peritonitis and for abdominal surgery in general was the foundation of experimental physiology and medicine by *Francois Magendy* and *Claude Bernard*, the development of cellular pathology by *Virchow*, the advent of the germ theory connected with the names of *Pasteur* and *Koch*, the introduction of antiseptics and asepsis by *Lister* and *Semmelweis*, the introduction of the systemic physical examination and the correlation between clinical and pathological findings by the Paris clinical school, and the introduction of general anaesthesia by *Wells* and *Morton*. With this background the knowledge of pathophysiology and bacteriology of peritonitis as well as the surgical treatment of the

disease developed rapidly around the turn of the century. The principles of the latter were summarized by *Kirschner* in 1926. The most important are mandatory surgical exploration, secure elimination of the focus of infection, and an effective peritoneal toilet.

Advances in the treatment of peritonitis during the last five decades were due to the advent of antibiotics and intensive care medicine, the better understanding of the synergism of bacteria in the peritoneal cavity, the systemic inflammatory response due to intraperitoneal infections, and the development of scoring systems and their application to patients with peritonitis.

Laparotomy is usually performed through an upper or lowermidline incision (depending on the suspected site of pathology). The objectives are to:

- ❖ establish the cause of peritonitis
- ❖ control the origin of sepsis by removal of the inflamed or ischaemic organ (or closure of the perforated viscous)
- ❖ perform effective peritoneal toilet/lavage.

MANAGEMENT PRINCIPLES OF PERITONITIS¹⁴

I. Supportive measures

- A. To combat hypovolemia and shock and maintain adequate tissue oxygenation
- B. To treat bacteria, not eliminated by surgery, with antibiotics
- C. To support failing organ systems
- D. To provide adequate nutrition

II. Operative treatment

Principle 1 (Repair)

Control the source of infection

Principle 2 (Purge)

Evacuate bacterial inoculum, pus, and adjuvants (peritoneal "toilet")

Principle 3 (Decompress)

Treat abdominal compartment syndrome

Principle 4 (Control)

Prevent or treat persistent and recurrent infection or verify both repair and purge

Control of the primary source of sepsis is essential. However, there is a trend towards undertaking primary anastomosis in patients with peritonitis (providing that they are haemodynamically stable and have no other significant risk factors).

There is little evidence of clinical benefit for peritoneal irrigation, possibly because of resistance of microbial peritoneal colonies to lavage, or concomitant damage inflicted to mesothelial cells. Rather than robust irrigation of the peritoneal cavity, removal of debris, faecal or purulent material may suffice.

Mass closure of the abdomen is undertaken using interrupted or continuous monofilament sutures. Antibiotics are continued for five days postoperatively in cases of generalized or complex peritonitis.

Re-laparotomy has an important role in the treatment of patients with severe secondary peritonitis who, after primary laparotomy, have ongoing or worsening features of sepsis. Reoperations may be performed 'on demand', or in a more aggressive 'planned' strategy at regular intervals. Planned relaparotomy often involves leaving the abdominal wall open with a sheet of synthetic mesh *in situ* to prevent evisceration. Modifications are 'primary open management', and semi-open approaches such as 'staged abdominal repair'. However, recent studies have concluded that in-hospital and long-term survival rates are higher in those patients managed by on-demand relaparotomy than in those with disease of comparable severity treated by planned relaparotomy.

Combining clinical data with frequent CT imaging is the key to timely and appropriate selection of patients requiring on demand

relaparotomy. However, it should always be remembered that many septic patients do not require relaparotomy but may simply require extended periods of mechanical ventilation, antimicrobials and organ support.

Obtaining effective control of sepsis at the first operation is vitally important because each subsequent operation is met with an increasing risk of morbidity and mortality.

Laparoscopy:

The theoretical risks of malignant hypercapnia and septic shock secondary to absorption of carbon dioxide and endo toxin through an inflamed peritoneum have not been proven. Instead, laparoscopy has proved effective in the management of acute appendicitis and perforated duodenal ulcer. It can be used in cases of colonic perforation, but the conversion rate to laparotomy is higher. Shock or major ileus are contraindications to laparoscopy.

Drains tend to be effective if used to drain a localized space, but are generally quickly 'walled off' and fail to drain the entire peritoneal cavity. There is a lack of evidence to support the prophylactic use of drain tubes after laparotomy.

VARIOUS FACTORS AFFECTING PROGNOSIS IN PATIENTS WITH PERITONITIS AND EVALUATION OF MANNHEIM PERITONITIS INDEX:

J. L. Dawson¹⁷ et al (1963) performed a study in which analysis of the record of 665 consecutive cases of diffuse peritonitis was undertaken to investigate factors affecting the mortality rate. The factors which were studied are the causal lesion, age, sex, the length of history and the method of treatment. About one third of cases were due to appendicitis and another third due to perforated duodenal ulcer.

There was a preponderance of male patients and it was largely accounted for by the large number of male patients with perforated duodenal ulcer.

The sex ratio in other condition is almost equal. Apart from patients with appendicitis the majority were aged above 40 years. In appendicitis there is little rise in mortality rate with age; this differs considerably from all the other groups.

The overall mortality rate ignoring sex, age, and the causal lesion, was 19.5%. The mortality rises with the age and below the age of 40 years the mortality was negligible. The difference in mortality between two sexes was not striking. In appendicitis there was little rise in mortality with increase in age. In perforated duodenal ulcer the mortality rises steeply after the age of 60 years. The mortality in perforated gastric ulcer was much higher than in perforated duodenal ulcer.

A study was conducted between 1935 to 1985 by Cecilie Svanes¹⁸. One thousand one hundred and twenty-eight patients treated for perforated gastro-duodenal ulcer during the year 1935 - 1985 were studied at the Haukeland University Hospital. The majority of patients (97.7 %) were treated surgically. The total post perforation lethality was 7.4%, the post surgical death rate was 6.6%, and the death rate among conservatively treated patients was 42.3%. Lethality was significantly influenced by year of hospital admission and increased markedly with age of the patients. For all age groups, the lethality decreased markedly with time. Treatment delay was associated with a moderate but significant increase in lethality. In patients with gastric ulcer the

lethality was 3.6 times higher than in those with duodenal ulcer. The death rate was similar in the duodenal and pyloric ulcer groups. Death rate decreased with time in both stomach ulcer, duodenal, and pyloric ulcer patients. There was no sex difference and no difference between patients treated with simple suture or gastric resection.

In 1987 Linder MM, Wacha H³, Feldmann U, Wesch G et al conducted a study based on experience with 1243 patients suffering from purulent peritonitis. 255 patients were included in the study and they were studied prospectively. For intra abdominal infection an index named the MANNHEIM PERITONITIS INDEX was established that allows for the first time to predict lethal outcomes of the disease in the individual patients.

Thereafter in 1988 Fugger R¹⁹ Validated the Mannheim peritonitis index. 113 patients suffering from purulent peritonitis entered this retrospective study for evaluation of the prognostic value of the Mannheim peritonitis index. There was no lethality below an index $x = 21$, between $x = 21$ and $x = 29$ % and lethality increased to 100% in patients with an index x greater than or equal to 30. Statistical validation showed that prognosis was correct in 93%. Between $x = 21$ and $x = 29$ prognosis of the MPI was correct in at least 65%. This study concluded that the Mannheim peritonitis index is a prognostic index for peritonitis with high accuracy in individual prognosis and that it is also very easily documented.

In 1994 the reliability of the Mannheim peritonitis index was assessed and its predictive power for different populations examined in a study of 2003 patients from seven centers in three European countries by Billing A, Frohlich D and Schildberg FW²⁰. The prevalence of risk factors varied considerably between the groups. For a threshold index score of 26, the sensitivity was 86 (range 54-98) percent, specificity 74 (range 58-97) percent and accuracy 83% (range 70-94) percent in predicting death. For patients with a score less than 21 the mean mortality rate was 2.3 (range 0-11) percent, for score 21-29 22.5 (range 10.6-50) percent, for score 21-29 22.5 (range 10.6-50) percent and for score greater than 29 59.1 (range 41-87) percent.

This study concludes that the mean index score and the mean mortality rate correlated in different groups, reflecting a homogenous standard of therapy for peritonitis and that the Mannheim peritonitis index provides an easy and reliable means for risk evaluation and classification for patients with peritoneal inflammations.

Demmel N²¹ et al studied 438 patients with intra abdominal infections prospectively. 300 of them were managed by closed treatment with drainage, 138 by open treatment with planned relaparotomy. 63 patients (14.4%) died, 34 of them due to sepsis, 29 due to another cause. In this study stepwise logistic regression analysis showed that only preoperative shock, concomitant disease and sepsis to be significant and independent factors leading to death. MPI had a strong correlation to mortality, statistical validation showed a sensitivity of 88% and a specificity of 78 at a critical score of 26 points. This study concludes that MPI is an early documented prognostic index for peritonitis with high accuracy in individual prognosis.

Liverania A, Correnti SF²² et al (1998) studied 235 patients operated on for acute peritonitis in a retrospective manner. The aim of this study was to estimate the prognostic reliability of

Mannheim peritonitis index. In this study the overall mortality was 8.1% for Mannheim peritonitis index score of less than 26 the mortality was 2% while the mortality was 40.5% for scores greater than 26. The study concluded that Mannheim peritonitis index is a threshold over which the therapeutic approach has to be more aggressive. Planned multiple laparotomies or the open abdomen technique could be the best option to explore and clean up the peritoneal cavity from septic debris.

Rogy M. Fugger R¹⁹ et al (1990) studied seventy patients suffering from purulent peritonitis. Two score were compared, the Mannheim peritonitis index and the APACHE II Score. The study concludes that the Mannheim peritonitis index is a prognostic index for peritonitis with high accuracy in individual prognosis. The simultaneous use of both the scores leads to a negligible improvement of prognostic accuracy. The sensitivity and specificity of MPI is more than that for the APACHE II Score.

Pacelli F²³ et al (1996) retrospectively reviewed 604 patients who consecutively underwent emergency operation for intra – abdominal infections. The study showed that the APACHE II Score, the Mannheim peritonitis index hypoalbuminaemia, hypercholesterolemia and preoperative organ impairment are independent predictors of death. They also concluded that the Mannheim peritonitis index has the advantage of being easier to calculate.

James M Watter²⁴ et al (1996) conducted a study to evaluate the influence of age on the evolutions and severity of peritonitis. They studied 122 patients with acute appendicitis and 100 patients with acute colonic diverticulitis requiring operation or per cutaneous drainage. They concluded that the biological before of peritonitis differ in the elderly, who are more likely to present with an advanced or severe process than young patients. They further stated that if these retrospective clinical observations reflect a generalisable, age related change in the biological features of peritonitis, then an understanding of the basis for such a change may allow improvement in the care of elderly surgical patients with abdominal infections.

Bosscha K²⁵ Reijnders K et al (1997) evaluated the various scoring systems such as the APACHE II Score, simplified acute physiology score, sepsis severity score, multiple organ failure score, Mannheim peritonitis index and the Ranson and Imrie score in about 50 patients. Additionally scoring systems were combined to obtain a combined score for the prediction of peritonitis related mortality. In this study it was found that only the APACHE II Score and the Mannheim peritonitis index provides the best scoring system fitting clinical goals.

Christian Ohmann² et al (1997) studied 355 patients of peritonitis confirmed at laparotomy. The objective of the study was to develop and to evaluate a new score to aid management of peritonitis. Computation of four different prognostic systems APACHE II; APACHE II and successful operation; APACHE II successful operation and Gori's score on first post operative day and the multivariate analysis was done. It was found that multivariate analysis is superior. From the analysis a new prognostic model (prognostic peritonitis model: PPM) was derived. The author finally concludes that clinical trials are required for the validation of this new score.

TM Cook²⁶ et al (1998) studied 107 patients age over 80 years undergoing urgent or emergency laparotomy. The factors

that predict hospital survival were studied. Age and ASA status were significant predictors of survival ($P<0.05$) and of anaesthetists prediction of mortality both before and after operation. They also found that women had a greater probability of dying. The estimated probability of death was increased in patients who were admitted to the ICU or who had invasive hemodynamic monitoring.

Sokmen S²⁷ (2001) studied three hundred and twenty five patients retrospectively. Among them 258 patients were discharged in a well condition with 67 patients died. In the patients who died the Mannheim peritonitis index score was always equal or more than 26. When all descriptive factors were revealed to be statistically significant between the exitus and the discharged group. They concluded that the Mannheim peritonitis index is effective scoring system in terms of predicting final outcomes in patients with peritonitis and intra abdominal sepsis.

Murat Kologlu²⁸ et al (2001) Studied 473 patients. 75 of these patients were operated for postoperative peritonitis and their data was compared with the remaining 398 patients with secondary bacterial peritonitis due to other causes. All patients were scored according to the Mannheim peritonitis index and the peritonitis index of ALTONA II score. Using multiple logistic regression, Mannheim peritonitis index and the peritonitis index of ALTONA II were combined in an equation and this new variable was called combined peritonitis score (CPS): $CPS = 9 + (0.8 \times MPI) + (-1.2 \times PIA II)$. All patients were scored according to Mannheim peritonitis index and the peritonitis index of ALTONA II and CPS. Receiver – operator characteristic (ROC) curves and sharpness of scores were compared. Also mean scores in both groups, proportions of correct predictions of outcome according to scores and correlation of scores with mortality were compared. Overall mortality was 17.8% in OTHER group and 33.3% in POSTOP group ($P=0.018$). Higher MPI scores, lower PIA II scores and higher CPS scores were associated with higher mortality in both groups ($P<0.0001$). mean MPI values were higher, mean PIA II values were lower and mean CPS value were higher in POSTOP group ($P<0.001$) the areas under ROC curves of CPS were bigger than MPI and PIA II in both groups. Sharpness of CPS was higher in both groups compared to MPI and PIA II ($P<0.05$).

Proportion of correct predictions of outcome was highest in CPS among the three scores ($P=0.0074$). CPS had the best correlation with observed mortality. They concluded that the Mannheim peritonitis index and the PI A II are scoring systems which are specially designed to predict outcomes in peritonitis and they depend mainly on preoperative and intraoperative objective criteria. They are practical and useful for clinical practice and clinical studies. They further concluded that instead of developing new scores modifying the existing scores would be more useful when this two indices were combined in the form of combined peritonitis score (CPS) all the parameters improved.

MM Corriea²⁹ et al (2001) studied 89 patients with cancer who undergo an emergency operation for secondary peritonitis. Frequencies of MPI component were calculated and the total score was obtained. The ages of the patient ranged from 0 to 89 with a mean of 58.4 years. 65 patients were men (73.3%) and 24 women (26.7%), only 8 patients were pre-operative and all other were post – operative. Most of the underlying causes were gastrointestinal. The overall mortality was 61.8%. The

preoperative duration of peritonitis was longer than 24 hours in 65.5%. Purulent exudates were observed in 63.3% and generalized diffuse peritonitis occurred in 62.2% of the patients. In 55.6% the origin of peritonitis was non – colonic and organ failure was observed in 48.9 % of cases. Comparison of the MPI variables in two groups showed that only organ failure, age older than 50 years and diffuse generalized peritonitis reached statistical significance. Preoperative peritonitis duration > 24 hours was slightly more frequent among patients who died than among survivors, but the difference was not significant. The mortality increased proportionally according to the MPI score. The authors recommended that *Mannheim peritonitis index* is accurate to be used for oncological patients with peritonitis but the MPI cut off should be adjusted for each hospital.

Scapellato (2004) studied 255 cases of secondary acute peritonitis. The Mannheim peritonitis index score was calculated for each patient to predict the peritonitis related in hospital mortality. The patients were divided into 3 groups according to MPI score of less than 21, between 21 to 29 and greater than 29. There was no mortality in the first group and there was significantly less mortality in the second group as compared to the third group. The study suggests that intervention time may be considered the main determinant of mortality in patients with peritonitis. This observation is especially relevant since intervention time is a modifiable risk factor while other factors are not modifiable.

Thomas Koperna³⁰ et al (2004) studied Eighty five emergency surgical patients admitted for the surgical ICU. The APACHE II Score was calculated before surgery, after admission to the ICU and on the postoperative days 3, 7 and 10. The study concludes that though longitudinal APACHE II Scoring reveals continuous improvement of the score in the surviving patients but it has no therapeutic relevance in the individual patients.

Rodolfo L³¹ et al (2002) studied 176 patients with acute perforation peritonitis. Patients were divided into groups according to the following categories (MPI points) : a) <21, 21-29, >29 and b) ≤ 26 and > 26. The mortality was about 6%. Each factor of the Mannheim peritonitis index was studied separately. Mean age of the patient was 34.6 years. The mean age of survivors was 32.7 years. Among the non-survivors the mean age was 63 years. Though age is a significant factor to predict mortality further studies may be undertaken to establish critical values related to age and intervals into which this variable should be subdivided. In this study patient with generalized peritonitis corresponds to 34% of patients.

Among survivors localized peritonitis was found more frequent than generalized peritonitis (68% vs. 32%) which in non survivors this relationship was inverted (27% vs. 73%) the extension of the peritonitis process was thus related with mortality. Considering survival related with the character of the peritoneal fluid they found that clear fluid had mortality of 5.8%, purulent fluid had mortality of 6.3% and faecal fluid had mortality of 25%, approximately 48% of patients were females and 52% were males with mortality rate of 7% and 6% respectively. It was not possible to calculate significance for the variables of presentation greater than 24 hours and organ failure because all deaths presented this adverse factor. Non colonic origin was also not found to be a significant factor in this study related to adverse outcomes as the mortality was 6% in pts with

non colonic origin of peritonitis and it was 15.38% in patients with colonic origin of sepsis. It was found that the anatomical origin of bacterial contamination and the microbiologic findings are not the main predictors of patient outcome. It was concluded the Mannheim peritonitis index is a useful method of determine outcome in patients of peritonitis. All the MPI adverse factors except the colonic origin of sepsis behaved as expected and the following were especially useful presence of organic failure, time elapsed > 24 hours, presence of malignancy, age greater than 50 years and the generalized extension of peritonitis.

Juan J³² et al (2003) studied 710 patients aged 70 years or older who underwent emergency surgery for intra-abdominal disorders. Patients were divided into two group one between 70 to 79 years and other greater than 80 years of age. In the analysis patient's age, sex, preoperative risk, the time interval between onset of symptoms and admission to hospital and between admission to surgery, type of surgery, operative findings, mortality, morbidity and the length of stay in hospital were studied.

The analysis reveals that most of the factors analysed increased mortality such as the ASA grading IV-V increased time lapse, intestinal infarction, malignant disease with distant metastasis and only palliative surgery. Independent mortality related factors were found to be preoperative risk (ASA grade), the time elapsed, disorders that only permit palliative surgery (gastrointestinal by pass, colostomy) or no surgical intervention (non therapeutic laparotomy) such as the advanced mesenteric vascular disease or advanced malignancy. In contrast to other studies increased age of the patient was not associated with higher morbidity or mortality.

Shuhei Komastu³³ et al (2003) studied 26 consecutive patients who underwent emergency operation for colorectal perforation. Several clinical factors were analyzed as possible predictive factors and APACHE II, SOFA, MPI and MOF Scores were calculated. The 26 patients comprise 14 men and 12 women. The mean age was 69 years. The overall mortality was 26.9% in this study with respect to the pre and perioperative clinical factors, Hinchey's stage III –IV, low preoperative market of pH, base excess and an MPI score of more than 30 were significant poor prognostic factors. Mortality was more in patients with diffuse peritonitis than in those with localized peritonitis. Concerning the post operative clinical factors low postoperative white blood cell count, Pao₂/Fio₂ ratio and renal output was associated with poor prognosis. The time from onset to operation did not significantly influence in hospital mortality in this study. The study also concludes that patients with an APACHE II score of 19, a SOFA score of 8 an MOF score of 7 and MPI score of 30 or more represents the highest risk group and early classification with this prognostic scoring systems to predict outcomes in desirable to select patients for appropriate antiseptic treatment.

Muluri K³⁴ et al (2004) retrospectively studied 66 patients with secondary peritonitis caused by gastrointestinal tract perforation. The overall hospital mortality rate was 30% significant risk factors in the univariate analysis includes advanced age, pre existing illness, chronic medications, hospital transfer, non-traumatic course of perforation, high Mannheim peritonitis index score and a high c-reactive protein level in the early post operative phase.

Kusumoto Yashiko³⁵ et al (2004) studied 108 patients operated on for intra abdominal infections (excluding the patients with appendicitis) the objective of the study was to evaluate the reliability of the Mannheim peritonitis index in predicting the outcome of patients with peritonitis. In this study the mortality was 5.3% in men and 15.2% in women with deaths occurring only in patients older than 50 years of age. The study demonstrates that the MPI score of 26 or less has mortality of 3.8% while score of more than 26 is associated with significant mortality thus establishing the score of 26 as an out off. The study concludes that the Mannheim peritonitis index is a simple and useful prognostic index for assessing the severity of peritonitis. The reliability of index may be improved by including complications associated with multiple organ failure and severe chronic health problems.

Abraal Maqbool Qureshi³⁶ et al (2005) studied on hundred and Twenty Six patients of secondary peritonitis who presented to the surgery unit II of the Rawalpindi general hospital. MPI score was calculated for each patient on a predesigned proforma and the patient was followed up till discharge or death. Death was the main outcome measure against which the MPI score was analysed under 2 categories i) <26 or ≥ 26 ii) <21 , $21-29$, > 29 . For MPI score ≥ 26 the mortality was 28.1% while it was 4.3% for scores less than 26, for a score less than the mortality was 1.8% for scores between 21 to 29 it was 21.9% and for score of 30 or more it was 28%.

Odds ratio calculated were significant for age > 50 year, malignancy, organ failure, preoperative duration > 24 hrs and cloudy, purulent exudates. The study concludes that increasing MPI score is strongly associated with the outcome.

Jyrki Tapani Makela³⁷ et al (2004) studied 172 patients with diverticular perforation. The clinical variables were evaluated as prognostic indicator of postoperative complications, mortality and the time of hospitalizations. The overall complication rate was 33% in patients under 70 years the Mannheim peritonitis index and the American society of anaesthesiologist (ASA) scores were independent prognostic factors. The Hinchey's classes and malnutrition also correlates with mortality. Only the Mannheim also correlates with mortality. Only the Mannheim peritonitis index was shown as a predictor of mortality. The study concludes that mortality is related to age but age alone is not an independent predictor of mortality. The MPI score is useful in the prediction of death in patients with diverticular perforation.

Ali Yaghoobi Notash³⁸ et al (2005) studied 80 consecutive patients with secondary peritonitis. The aim of the study was to predict the outcome of patients with peritonitis using the Mannheim peritonitis index and the multiple organ failure score. The MPI and the revised and original MOF scores were calculated at admission or during management. Patients were followed up until death or discharge non survivors had higher mean original and revised MOF scores (6.8 and 4.8) whereas survivors had mean MOF score of 0.3. Survivors had mean MPI of 19.39 but that of non survivors was 33.07. The risk of in hospital mortality was higher in patients aged above 60 years and time interval from presentation until surgery of greater than 24 hours.

The MPI has been shown to be an appropriate objective prognostic factor in patients with peritonitis to predict the

outcome. The study finally says that a combination of MPI and MOF can give better results.

Rajendra Singh Jhobta³⁹ et al reviewed say consecutive cases of perforation peritonitis over a period of five years in terms of clinical presentation, operative findings and the post-operative course at GMCH Chandigarh. The objective of the study was to highlight the spectrum of perforation peritonitis encountered therein. The most common cause of perforation in this series was perforated duodenal ulcer (289 cases) followed by appendicitis (59 cases), GI perforation due to blunt trauma abdomen (45 cases), typhoid fever (41 cases) and tuberculosis (20 cases). Despite delay in seeking medical therapy (53%) the overall mortality was 10% but the morbidity was unusually high at 50%. The study concludes that in contrast to the western literature where lower GI tract perforations predominate, upper GI tract perforation constitutes majority of cases in India. The author also sounds warning due to the increase in the number of GI tract perforations due to blunt abdominal trauma as a result of high speed motor vehicular accident and warrants early recognition and prompt treatment.

Atsushi Floriuchi⁴⁰ et al (2007) studied 26 patients (9 men, 17 women) with mean age of 72.7 ± 11.6 year who underwent emergency surgery for colorectal perforation. Several clinical factors were measured preoperatively and 19 hours postoperatively. APACHE II Score, the Mannheim peritonitis index and the peritonitis index Altona was calculated preoperatively. APACHE II Score was significantly less in survivors than in non survivors. Non survivors tend to display a high Mannheim peritonitis index score and a low PIA score, but no significant difference was identified.

Thomas E Riz⁴¹ and Tom bates performed a search of the literature of ram 1977 – 2007 using midline this search was performed to identify those predictive risk scores relevant to sick elderly patients in whom emergency surgery may be life saving. The study concludes that risk scores may be help but in sick elderly patients needing emergency abdominal surgery an experience clinical opinion is still essential.

Jebrey Vermeulen⁴² et al (2007) studied 200 consecutive patients with acute perforated diverticulitis. Mortality and morbidity was compared in relation to type of surgery. ASA classification, age, gender, Mannheim peritonitis index, Hinchey score, surgeon's experience and type of operation. The object of this study was to compare patients of perforated diverticulitis treated either with primary anastomosis or Hartmann's procedure. Total mortality was 27%, 47 patients died after Hartmann's procedure compare to 7 after primary anastomosis. Age, Mannheim peritonitis index and the ASA score were significantly related to mortality. The study concludes that whether to do Hartmann's procedure or a primary anastomosis should be done taking into account the patients concomitant disease, response of preoperative resuscitation and the availability of a surgeon experienced in colorectal surgery.

M Hyninen⁴³ et al (2007) studied 163 consecutive patients with secondary peritonitis. 58 patients among this were treated in an ICU. The hospital mortality was 19% and one year mortality was 23%, on admission 44 patients (27%) were in septic shock and 10 patients (6%) presented with severe sepsis. Mortality varied with the site of perforation and highest mortality was noted in colonic and biliary perforation. In 5 patients malignancy

was the etiological factor and all of them survived for 1 year. Analysis revealed that APACHE II Score, previous functional status and the sepsis category were independent predictors of mortality. SOFA score (sequential organ failure assessment) was assessed in patients admitted to ICU and it was shown to have the best predictive power for mortality. The study highlights the importance of early recognition, prevention & treatment of organ dysfunction in our attempt to improve the short and long term outcome of patients with peritonitis.

CG Nwigwe⁴⁴ et al (2007) studied 67 consecutive patients with generalized peritonitis. The clinical data and the Mannheim peritonitis index were collected manually for each patient after the surgery. The Mannheim peritonitis index score was related to mortality and the long stay in the hospital which donates morbidity. The mean MPI score for survivors was 30.6, for MPI > 30 mortality was 92.3%. In this study the cut off point for Mannheim peritonitis index of 25 was associated with the highest degree of accuracy.

Cristian P. Schneider⁴⁵ et al evaluated a cohort of 319 consecutive patients with secondary peritonitis requiring intensive care treatment. Four month mortality was calculated and it was related to various variables such as the sex, emergency admissions, main source of infection, adequacy of empirical antibiotic therapy, presence of malignancy, palliative or curative surgery, need for ventilation and admission, presence of pneumonia/ liver cirrhosis, age, APACHE II Score on admission day, duration of artificial ventilation, duration of catecholamine therapy, need for renal replacement therapy, no. of transfused red cell units and need for surgical revisions. Four month survival after ICU admission was 31.7%, 1 year survival was 82.7%. Inability to control the source of infection was the most important determinant of mortality.

Other factors associated with worse 4 monthly survival were high disease severity at ICU admission and during the ICU stay, specific co morbidities such as the extended malignancies and presence of liver cirrhosis, source of infection being distal oesophagus and stomach and inadequate empirical antibiotic therapy.

Chao-Wen-Hsu⁴⁶ studied spectrum of malignant small bowel perforations data on 19 patients (6 women and 13 men), with malignancy perforation through small bowel tissue was

retrospectively reviewed. The median patient age was 57 year (range, 41-48 years). The histopathology included lymphoma (seven patients), leiomyosarcoma (two patients), metastatic carcinomas with unknown primary tumour (seven patients), gastrointestinal stromal tumour (one patient), adenocarcinoma (one patient), metastatic carcinomas with unknown primary tumour (four patients) and metastatic adenocarcinoma from the lung (one patient). Resection of a segment of perforated bowel with primary anastomosis was performed in 16 patients, wedge resection of perforated lesion with plication in two patients, and loop ileostomy in one patient. Postoperative deaths occurred in 10(52.6%) patients, owing to sepsis and organ functional failure, seven patients died from the primary malignancy at a median follow up of 6.5 month (range, 5 months to 1 year 9 months) after surgery. Moreover, two patients with small bowel lymphoma were alive with disease at 4 years 8 months and 7 years 1 month after surgery. In conclusion, perforation through small bowel malignant tumours had a high postoperative mortality rate. High index of suspicion of the disease with early surgical treatment may improve treatment outcomes.

A Mishra⁴⁷ et al of G. I. Surgery Unit, Department of Surgery, NSCB Government Medical College, Jabalpur, Madhya Pradesh Constructed and Assessed a simplified scoring system for peptic perforation, which can be easily used in developing countries. One hundred and forty consecutive patients with perforated pre-pyloric or duodenal ulcer undergoing Graham patch omentopexy closure were studied prospectively. Each factor was given a score based on its severity in accordance with the APACHE –II scoring system to construct the simplified prognostic (Jabalpur) Scoring system, and multiple regression analysis was used to identify risk factors, this system was prospectively validated in the next 50 consecutive patients and compared to existing systems. Factors associated with mortality were age, presence of co-morbid illness, perforation- to- operation interval, preoperative shock, heart rate, and serum creatinine. The mean score in survivors (4.9) was less than that in those who died (12.5 p<0.0001). This scoring system compared favourably with other scoring systems. The Jabalpur scoring system is effective for prognostication in case of peptic perforation. It is simple and user-friendly as it uses only six routinely documented clinical risk factors.

VI. OBSERVATION AND ANALYSIS

Table 1a: Number of patients in each age group

Age group (years)	Frequency	Percent
<15	14	7.0
15-30	28	14.0
31-45	55	27.5
46-60	57	28.5
61 and above	46	23.0

The mean age of the study group was 43.74 years and the age group of 46-60 contains maximum (28.5%) patients followed by 31 – 45 years. Oldest patients was 84 years and youngest was of 9 days.

Table 1b: Showing age distribution of the patients (< 50 years & > 50 years)

Age groups (years)	Frequency	Percent
<50	119	59.5
50 or more	81	40.5

Table 2: Showing sex distribution of the patients

Sex	Frequency	Percent
Male	136	68.0
Female	64	32.0

Table 3: Showing anatomical site of perforation in study patients

Site of perforation	Frequency (n = 200)	Percent
DUODENAL PERFORATION	67	33.5
COLONIC PERFORATION	25	12.5
ILEAL PERFFORATION	51	25.5
APPENDICULAR PERFORATION	16	8.0
GASTRIC PERFORATION	13	6.5
JEJUNAL PERFORATION	7	3.5
GALL BLADDER PERFORATION	7	3.5
MECKEL'S DIVERTICULUM PERFORATION	3	1.5
URINARY BLADDER PERFORATION	3	1.5
CBD PERFORATION	2	1.0
ILEAL AND UTERINE PERFORATION	1	.5
UTERINE PERFORATION	3	1.5
HYDATID CYST PERFORATION	1	.5
RECTAL PERFORATION	1	.5

As the table shows maximum number of patients had duodenal perforation 67

(33.5 %) followed by Ileal perforation 51 (25.5 %). Colonic, appendicular and gastric perforations were 25 (12.5 %), 16(8 %) and 13(6.5%) respectively. Rectal, hydatid cyst of liver and combined ileal - uterine perforations were among the least common perforations i.e.1 (0.5 %).

Site of perforation

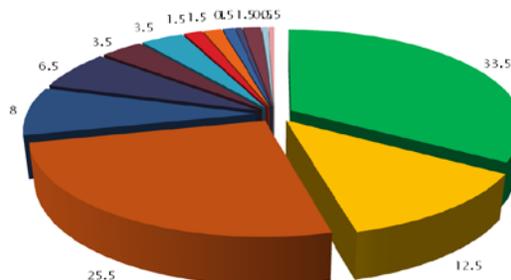


Figure 1: Showing anatomical site of perforation in study patients

Table 4: Showing various clinical features in patients with peritonitis

Symptoms		Frequency	Percent
Abdominal pain	Absent	6	3.0
	Present	194	97.0
Distension	Absent	94	47.0
	Present	106	53.0
Not passed Flatus	Absent	118	59.0
	Present	82	41.0
Not passed Stools	Absent	119	59.5
	Present	81	40.5
Fever	Absent	84	42.0
	Present	116	58.0
Vomiting	Absent	77	38.5
	Present	123	61.5

The commonest symptom was abdominal pain seen in 194 (97 %) patients followed by vomiting & abdominal distension seen in 123 (61.5 %) & 106 (53%) respectively.

Table 5: Showing various intraoperative procedures done

Intraoperative Procedures	Frequency	Percent
EL & OMENTAL PATCH REPAIR	63	31.5
LAPAROSCOPIC CLOSURE OF PERFORATION	1	.5
EL & PERITONEAL LAVAGE WITH DRAIN TUBE INSERTION	7	3.5
TRANSEVERSE COLOSTOMY	4	2.0
TUBE DUODENOSTOMY WITH FJ	1	.5
EL WITH RA (RESECTION & ANASTOMOSIS)	27	13.5
EL WITH PRIMARY CLOSURE	57	28.5
EL WITH RA WITH ILEOSTOMY	3	1.5
EL WITH HEMICOLECTOMY	4	2.0
EL WITH APPENDECTOMY	13	6.5
EL WITH ILEOSTOMY	2	1.0
DISTAL GASTRECTOMY WITH GJ	2	1.0
HARTMANN'S PROCEDURE	3	1.5
HEMICOLECTOMY WITH ILEOSTOMY	3	1.5
EL WITH PRIMARY CLOSURE WITH TRANSEVERSE COLOSTOMY	3	1.5
EL WITH CHOLECYSTECTOMY	7	3.5

Most common procedure performed was exploratory laparotomy with omental patch repair in 63 (31.5 %) patients followed by primary closure and resection and anastomosis in 57(28.5%) and 27 (13.5%) patients respectively 1(0.5%) patient underwent laparoscopic closure of duodenal perforation 1(0.5%) patient underwent tube duodenostomy with feeding jejunostomy.

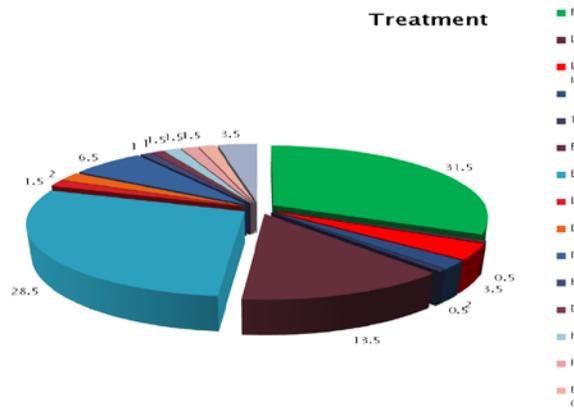


Figure 2: Showing various intraoperative procedures done.

Table 6: Showing distribution of organ failure in patients with peritonitis

Organ failure	Frequency	Percent
Absent	155	77.5
Present	45	22.5

In present study 45 i.e.22.5 % patients showed presence of organ failure

Table 7: Showing preoperative duration wise distribution of patients

	Preoperative duration	Frequency	Percent
1.	<24 hours	32	16.0
2.	24 hours and more	168	84.0

Table 8: Showing presence of malignancy in patients with peritonitis

Malignancy	Frequency	Percent
Absent	186	93.0
Present	14	7.0

Table 9: Table showing origin of sepsis (colonic /noncolonic) in our study

Origin of sepsis	Frequency	Percent
Non-colonic	175	87.5
Colonic	25	12.5

In our study 25 i.e.12.5 % patients origin of sepsis was colonic while in 175 i.e. 87.5 % patients origin of sepsis was noncolonic.

Table 10: Showing type of peritonitis in study population

Type of peritonitis	Frequency	Percent
Localised	26	13.0
Diffuse	174	87.0
Total	200	100.0

In our study 174 i.e. 87 % patients had Diffuse peritonitis while 26 i.e.13 % had localised peritonitis

Table 11: Showing character of exudates in study population

Exudate	Frequency	Percent
Clear	40	20.0
Purulent	124	62.0
Fecal	36	18.0

In our study 124 (62%) patients had purulent exudates while clear & fecal exudates were present in 40 (20%) & 36 (18%) patients respectively.

Table 12: Showing MPI score wise distribution of patients

MPI	Frequency	Percent
<21	87	43.5
21-29	70	35.0
>29	43	21.5

In 87 (43.5 %) patients total MPI score was < 21 while 70 (35%) patients total score was 21-29 & it was > 29 in 43 (21.5%) patients

Table13: Showing outcome of the patients in our study

Outcome	Frequency	Percent
Discharged	168	84.0
Death	32	16.0

Table 14: Showing mortality in each age group

Age Group (years)		Mortality in age group	Total mortality
<15	N	0	0
	%	.0%	.0%
15-30	N	1	1
	%	3.6%	3.1%
31-45	N	3	3
	%	5.5%	9.4%
46-60	N	14	14
	%	24.6%	43.8%
61 and above	N	14	14
	%	30.4%	43.8%

The highest mortality was in the age group 61 years & above followed by 46 - 60 years. The lowest mortality was in the age group < 15 years followed by 15-30 years.

Table 15: Showing correlation of Age > 50 yrs with incidence of mortality

Age group	Outcome		Mortality according to age	X ²	Df	p-value
	Discharged	Death				

			group			
<50 (n)	112	7	7	22.12	1	<0.001
%	94.1%	5.9%	21.9%			
50 or more (n)	56	25	25			
%	69.1%	30.9%	78.1%			

$X^2 - 22.12$ $d(f) - 1$ $p - < 0.001$

In correlation between Age > 50 yrs with incidence of mortality, our study showed statistically significant result with $p < 0.001$

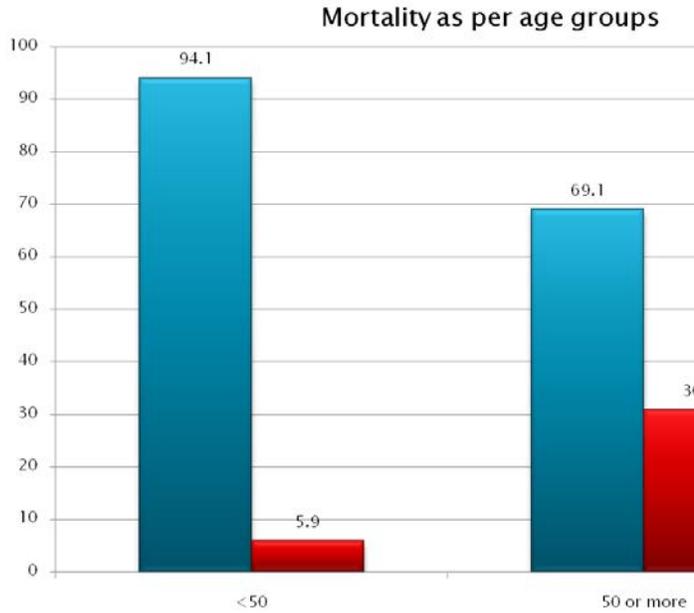


Figure 3: Showing correlation of Age > 50 yrs with incidence of mortality

Table 16: Showing correlation of sex with incidence of mortality

Sex	Outcome		Mortality according to gender	X^2	Df	p-value
	Discharged	Death				
Male (n)	112	24	24	0.858	1	0.354
%	82.4%	17.6%	75%			
Female (n)	56	8	8			
%	87.5%	12.5%	25%			

$X^2 - 0.858$ $d(f) - 1$ $p - 0.354$

In correlation of sex with incidence of mortality, p value in our study was 0.354 which is statistically not significant & shows contrast results with MPI.

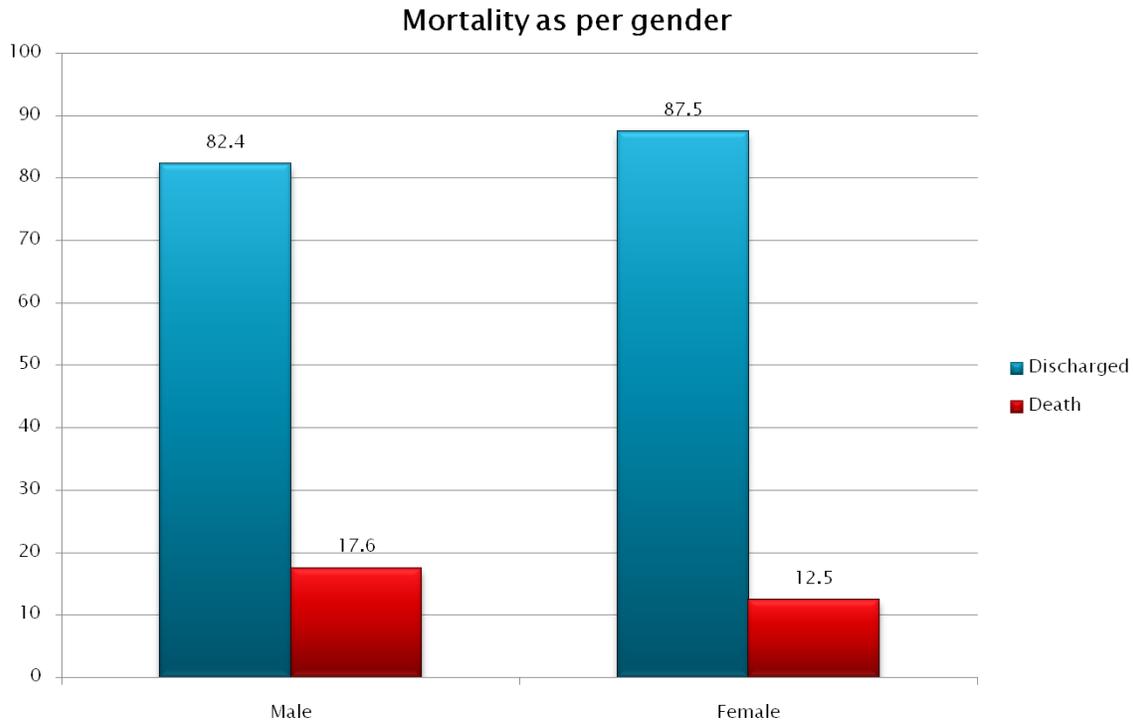


Figure 4: Showing correlation of sex with incidence of mortality

Table 17: Showing correlation of organ failure with incidence of mortality

Organ failure	Outcome		Mortality according to Organ failure	X ²	Df	p-value
	Discharged	Death				
Absent (n)	153	2	2	110.91	1	<0.001
%	98.7%	1.3%	6.3%			
Present (n)	15	30	30			
%	33.3%	66.7%	93.8%			

X²- 110.91 d(f)- 1 **p<0.001**

In correlation of organ failure with incidence of mortality p value in our study was **< 0.001** which is statistically significant.

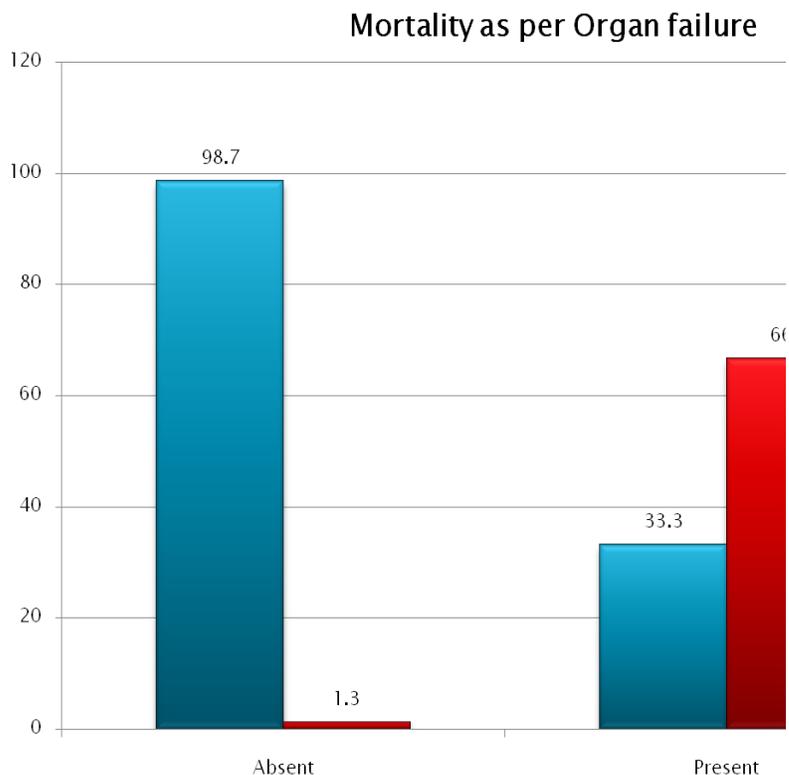


Figure 5: Showing correlation of organ failure with incidence of mortality

Table 18: Showing correlation of preoperative duration with incidence of mortality

Pre-op duration	Outcome		Mortality according to Pre-op duration	X ²	Df	p-value
	Discharged	Death				
<24 hours (n)	32	0	0	7.256	1	0.007
%	100.0%	.0%	0			
24 hours and more (n)	136	32	32			
%	81.0%	19.0%	100%			

X²- 7.256 d (f) -1 p - <0.007

In correlation of preoperative duration with incidence of mortality, our study showed statistically significant result with **p <0.007**.

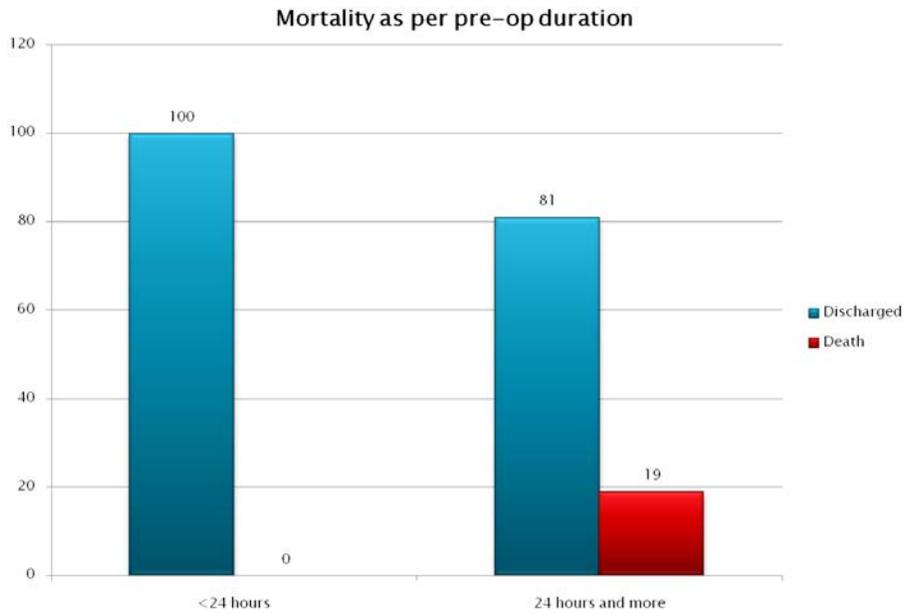


Figure 6: Showing correlation of preoperative duration with incidence of mortality

Table 19: Showing correlation between presence of malignancy with incidence of mortality

Malignancy	Outcome		Mortality according to Malignancy	X ²	Df	p-value
	Discharged	Death				
Absent (n)	163	23	23	26.12	1	<0.001
%	87.6%	12.4%	71.9%			
Present (n)	5	9	9			
%	35.7%	64.3%	28.1%			

X² – 26.12 d(f) – 1 p - <0.001

In correlation between presence of malignancy with incidence of mortality, our study showed statistically significant result with **p <0.001**

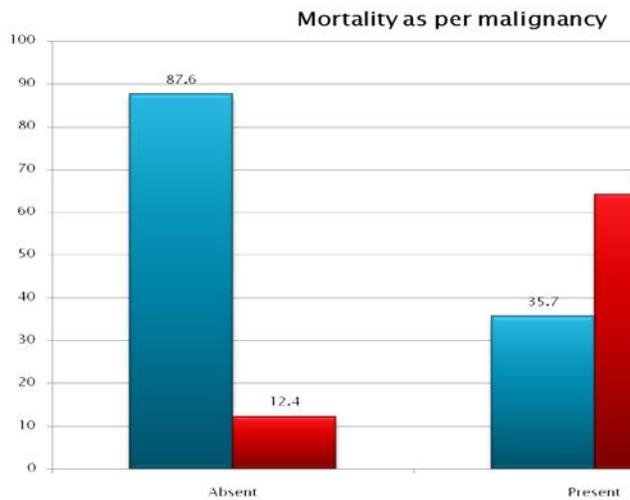


Figure 7: Showing correlation between presence of malignancy with incidence of mortality

Table 20: Showing correlation between type of peritonitis with incidence of mortality

Peritonitis	Outcome		Mortality according to Peritonitis	X ²	Df	p-value
	Discharged	Death				
Localised (n)	26	0	0	5.692	1	0.017
%	100.0%	.0%	0			
Diffuse (n)	142	32	32			
%	81.6%	18.4%	100			

$X^2 - 5.692$ $d(f) - 1$ $p - <0.017$

In correlation between type of peritonitis with incidence of mortality, our study showed statistically significant result with $p < 0.017$

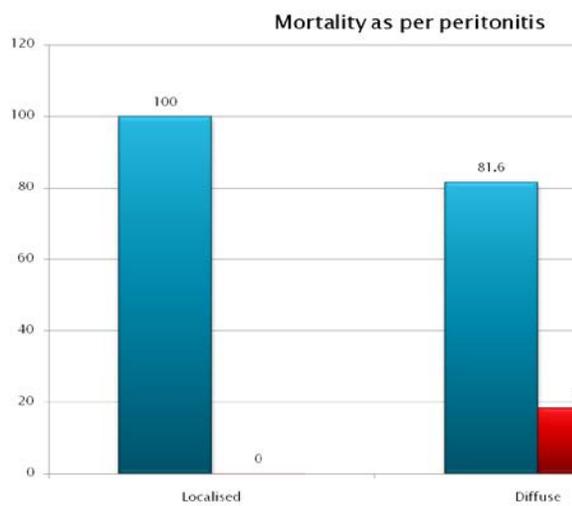


Figure 8: Showing correlation between type of peritonitis with incidence of mortality

Table 21: Showing correlation between origin of sepsis (colonic / noncolonic) with incidence of mortality

Diagnosis	Outcome		Mortality according to diagnosis	X ²	Df	p-value
	Discharged	Death				
Non Colonic(n)	150	25	25	3.061	1	0.145
%	85.7%	14.3%	78.1%			
Colonic (n)	18	7	7			
%	72.0%	28.0%	21.9%			

$X^2 - 3.061$ $d(f) - 1$ $p - <0.145$

In correlation between origin of sepsis (colonic / noncolonic) with incidence of mortality p value in our study was 0.145, which is statistically not significant & shows contrast results with MPI.

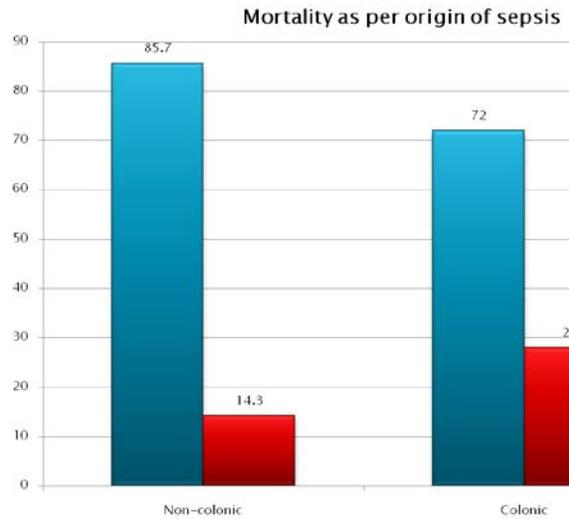


Figure 9: Showing correlation between origin of sepsis (colonic / noncolonic) with incidence of mortality

Table 22: Showing correlation between character of exudate with incidence of mortality

Exudate	Outcome		Mortality according to exudates	X ²	Df	p-value
	Discharged	Death				
Clear (n)	38	2	2	18.52	2	<0.001
%	95.0%	5.0%	6.3%			
Purulent (n)	108	16	16			
%	87.1%	12.9%	50%			
Fecal (n)	22	14	14			
%	61.1%	38.9%	43.8%			

X²- 18.52 d (f) – 2 p- < 0.001

In correlation between character of exudate with incidence of mortality, our study showed statistically significant result with p < 0.001

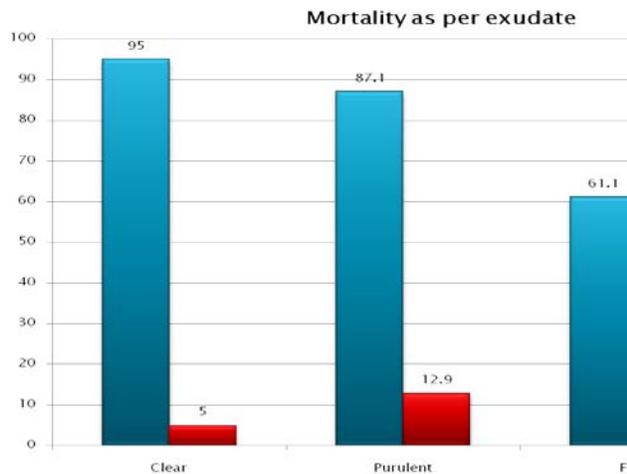


Figure 10: Showing correlation between character of exudate with incidence of mortality

Table 23: Showing duration of hospital stay of the patients

Hospital stay	Frequency	Percent
<10 days	43	21.5
10-20 days	125	62.5
21-30 days	24	12.0
>30 days	8	4.0

In our study most of the patients i.e. 125 (62.5 %) stay in the hospital for 10 - 20 days while 8 (4 %) patients stay in the hospital for > 30 days.

Table 24: Showing correlation of MPI score with incidence of mortality

MPI	Outcome		Mortality according to MPI	X ²	Df	p-value
	Discharged	Death				
<21 (n)	87	0	0	108.38	2	<0.001
%	100.0%	.0%	0			
21-29 (n)	67	3	3			
%	95.7%	4.3%	9.4%			
>29 (n)	14	29	29			
%	32.6%	67.4%	90.6%			

X²- 108.38 d(f)- 2 p-<0.001

In our study mortality rate among patients with MPI score > 29 was 67.4% and with MPI < 21 was 0, which is statistically significant with p <0.001

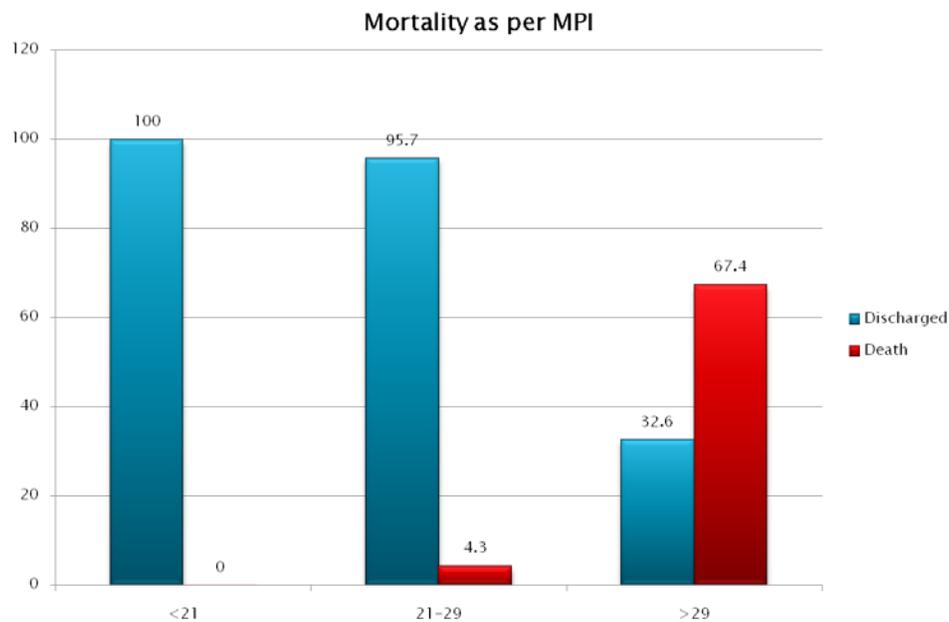


Figure 11: Showing correlation of MPI score with incidence of mortality

Table 25: Showing distribution of MPI variables and outcome of patients

Variables		Outcome		p-value
		Discharged	Death	
50 or more years (n)		56	25	<0.001
%		69.1%	30.9%	
Female (n)		56	8	0.354
%		87.5%	12.5%	
Organ failure (n)		15	30	<0.001
%		33.3%	66.7%	
24 hours or more duration (n)		136	32	0.007
%		81.0%	19.0%	
Malignancy (n)		5	9	<0.001
%		35.7%	64.3%	
Diffuse peritonitis (n)		142	32	0.017
%		81.6%	18.4%	
Exudate	Clear (n)	38	2	<0.001
	%	95.0%	5.0%	
	Purulent (n)	108	16	
	%	87.1%	12.9%	
	Fecal (n)	22	14	
	%	61.1%	38.9%	
Noncolonic (n)		150	25	0.08
%		85.7%	14.3%	

In our study correlation between noncolonic origin of sepsis and female sex with outcome did not showed statistically significant results while other factors showed statistically significant results.

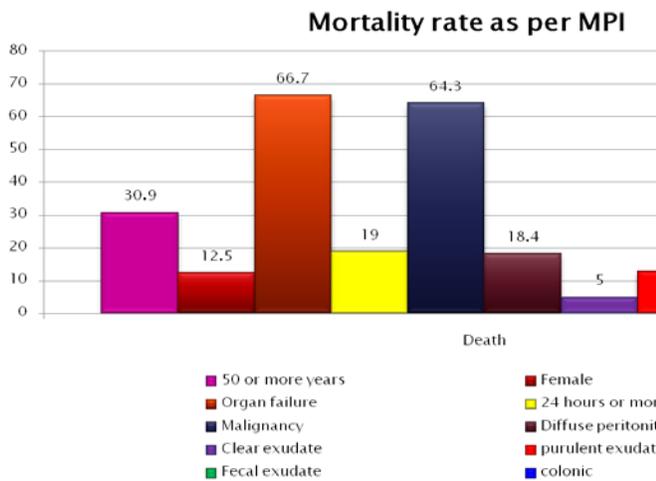


Figure 12: Showing distribution of MPI variables and outcome of patients

Table 26: Showing microbiological profile in patients with peritonitis

S. no.	Type of microorganism	Number of patients
1.	Sterile	20

2.	E.Coli	15
3.	Klebsiella	08
4.	Pseudomonas	06
5.	Enterococcus	01

Random sample of 50 patients were drawn and it showed above mentioned results.

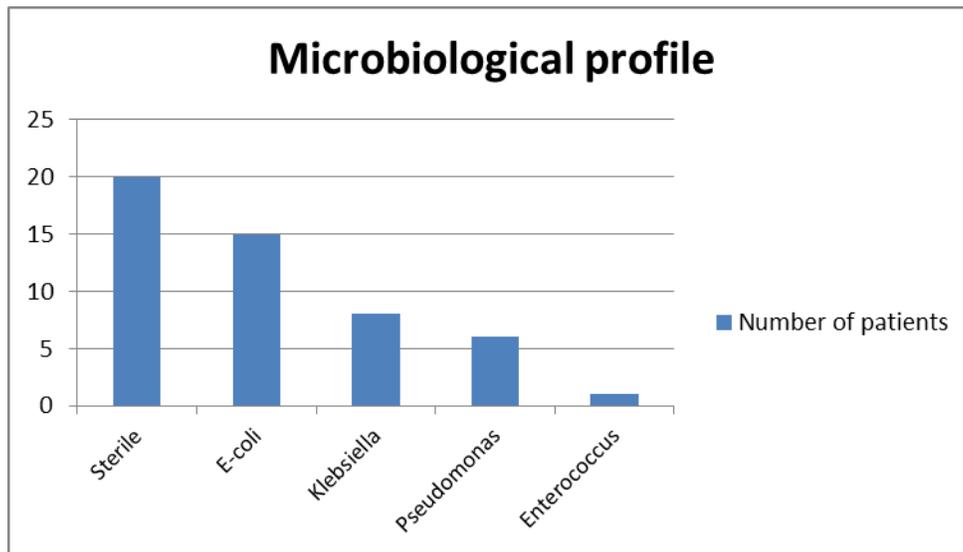


Figure 13: Showing microbiological profile in patients with peritonitis

VII. DISCUSSION

SPECTRUM OF PERFORATION PERITONITIS

AGE (Table 1a & 1 b)

- Total of 200 patients were studied.
- The age range is from 9 days to 84 years. The mean age of the study population was 43.7 years.
- The highest numbers of patients were found in the age group of 46-60 years and they constitute about 28.5% of the study population.

In a study by Rajendra Singh Jhobta³⁹ et al (2006) the mean age was 36.8 years and the age range was 3 years to 90 years. In a study by Aijaz A Memon⁴⁸ (2008) in which the spectrum of acute abdomen was studied the age range was from 13 years to 87 years.

AUTHOR	YEAR	AGE (yrs)
Ohmann C et al	1997	56
Roduez et al	1999	39.8
Corriea et al	2001	58.9
Rodofo L et al	2002	34.6
Present Study	2011	43.7

- The number of patients in the age group <50 years were 119 i.e. 59.5% and 81 patients of the study population i.e. 40.5% were in the age group >50 years.

- ▶ The increased prevalence of the perforation in the age group of 31- 60 years in our study can be attributed to the fact that gastro duodenal perforations due to peptic ulcer disease is a major cause of perforation peritonitis in our study and the increased prevalence of the etiological risk factors such as smoking, alcoholism and NSAID abuse in this age group.
- ▶ After increasing steeply at the beginning of the twentieth century perforation incidence during the last decade has declined in young and has risen among elderly. These changes can be attributed to the cohort phenomenon: ulcer perforation risk is particularly common in the cohorts born after the turn of 20 century and is less common in previous and succeeding cohorts³⁰.
- ▶ It is also attributed to the increased numbers of traumatic perforations in the younger age group leading to parallel increase in the overall prevalence of perforation peritonitis in this age group. Also appendicular perforation is more common in the age group of 20-30 years but no age is exempted. Majority of the ileal perforations are seen in the age group of 10-30 years, typhoid being the main etiological factor.

Sex (Table 2)

- ▶ In our study the incidence of male sex was 68 % while that of female sex was 32 %.
- ▶ In a study by Rajender Singh Jhobta³⁹ (2006) regarding the spectrum of perforation peritonitis in India 84% patient’s were male.

AUTHOR	YEAR	FEMALE	MALE
Tripathi et al.	1993	45.5 %	54.5 %
Yilmazlar et al.	1999	37 %	63 %
Corriea et al.	2001	26.7 %	73.3 %
Rudolfo L et al.	2002	48 %	52 %
Present study	2011	32 %	68 %

In a study by Rajender Singh Jhobta³⁹ regarding the spectrum of perforation peritonitis in India , 422 of the 504 patients studied were males i.e.84%.

In a study by Aijaz A Meman⁴⁸ (2008) et al about the spectrum of disease in patients with acute abdomen, 70.30 % was males and 29.69% were females.

In a study by Rudolfo L³¹ (2004) out of the 174 patients, 84 were females (48%) and 90 were males (52%).

- The increased prevalence of male sex in our study is mainly due to increased number of male patients in the category of duodenal perforation

SITE OF PERFORATION (Table 3)

In our study duodenal perforations account for 33.5%, illeal perforation for 25.5%, colonic perforation for 12.5%, appendicular perforations for 8% ,gastric perforation for 6.5 %, jejunal and gall bladder perforations for 3.5 % each, meckel’s diverticulum and urinary bladder perforations for 1.5 % each & CBD perforation in 1 % of patients.

Rectal and hydatid cyst of liver perforations were among the least common perforations, constituting 0.5 % in each group. In a study by Rajender Singh Jhobta et al³⁹ (2006) the result was as below:

duodenum 57%, gastric 8%, jejunal 3%, ileal 15%, appendicular 12%, colonic 4% and oesophageal 0.5 %.

SITE	Tripathi et al (1993)	Desa L.A et al (1983)	Kachroo et al.(1984)	Bohner et al.(1999)	Present study
Duodenal	15 %	32.29 %	18.7 %	22.7 %	33.5 %
Ileal	24.5 %	27.3 %	15 %	-	25.5 %
Appendicular	10 %	18.1 %	41.1 %	15.9 %	8 %
Others	50.5%	22.31%	25.2%	61.4%	36%

In a study by Rodolfo L³¹ et al appendicular perforations constitute 48.28% while gastric pathology and small bowel pathology constitutes 2.87% each and colonic pathology 2.30%. The increased number of duodenal perforations in our study is due to increased prevalence of the acid peptic disease. Also the increase number of jejunal perforations all of which were secondary to trauma reveals the hazard of trauma.

The perforations of the proximal gastro intestinal tract were six times as common as the perforations of the distal gastrointestinal tract as has been noted by earlier studies from India. This is in sharp contrast to studies from the developed countries which reveal that distal gastrointestinal tract perforations are more common³¹.

Clinical features (Table 4)

- ▶ In our study pain in abdomen was the most common symptom and 97 % of patients had pain abdomen at presentation while 41% of patients have difficulty in passing flatus or motion.
- ▶ Distension of abdomen was present in 53 % of patients, 61.5% patients had episodes of vomiting, 58 % patients had fever at presentation.
- ▶ In a study by Shantanu Kumar Sahu et al⁴⁹ the commonest presenting symptom was abdominal pain (100%), followed by distension of abdomen (82%), constipation, vomiting and fever.
- ▶ In a study by Rajender Singh Jhobta et al³⁹ pain was present in 98% of patients, followed by vomiting (59%), abdominal distension (44%), constipation (58%), fever (35%), and diarrhoea (7%).
- ▶ Perforation peritonitis is a clinical condition with a wide spectrum of presentation and high index of suspicion is always warranted.
- ▶ Not every patients of perforation peritonitis will present with signs of pain, distension of abdomen, guarding and rigidity of the anterior abdominal wall. A thorough examination from head to toe is mandatory in every patient.
- ▶ Diagnosis of perforation peritonitis is always clinical and immediate resuscitative measures should be initiated.
- ▶ Radiological investigations are only for the confirmation of diagnosis. Unnecessary investigations unless the diagnosis is in doubt should be avoided, and after initial adequate resuscitation exploratory laparotomy should be done in an emergency basis. Delay in treatment can lead to the development of sepsis and multiorgan failure with concomitant increase in morbidity and mortality of patients

INTRA OPERATIVE PROCEDURE DONE (Table 5)

- ▶ EXPLORATORY LAPAROTOMY and OMENTAL PATCH REPAIR was done in patients with duodenal perforation.
- ▶ 1 patient underwent laproscopic closure.
- ▶ 27 (13.5 %) patients underwent resection and anastomosis, while in 3 (1.5%) patients ileostomy was done along with resection and anastomosis.
- ▶ 3 (1.5 %) patients underwent hemicolectomy.
- ▶ 3 (1.5 %) patients underwent tranverse colostomy.
- ▶ 3 (1.5 %) patients underwent Hartmann’s procedure.

In our study no patients was managed by a definitive procedure for acid peptic disease. All the patients with gastroduodenal perforation due to acid peptic disease were prescribed proton pump inhibitor at the time of discharge.

Primary closure of the gastroduodenal perforation with edge biopsy with omental patch was done in all of the cases of gastroduodenal perforations of peptic origin.

In the study by Rajender Singh Jhobta³⁹ 304 patients i.e. 60% were managed by simple closure of perforations, 46 patients i.e. 9% were managed by resection and anastomosis. Resection without anastomosis was done in 64 patients, ileostomy

/colostomy with mucous fistula / Hartmann’s procedure was done in these patients. Definitive procedure in the form of Billroth I and II gastrectomy with truncal vagotomy and drainage procedure was done in 33% patients and appendectomy in 57 patients.

- ▶ The classic, pedicled omental patch i.e. performed for the plugging of this perforation was first described by Cellan Jones in 1929, although it is commonly and wrongly attributed to Graham, who described the use of a free graft of the omentum to repair the perforation in 1937. However large perforations may be encountered in which there exists the threat of postoperative leakage following closure by the simple method. Here other surgical options such as partial gastrectomy, jejunal serosal patch, jejunal pedicled graft or even gastric disconnection may be deemed necessary for the secure closure.

DISTRIBUTION OF ORGAN FAILURE (Table 6)

- ▶ In our study 45 patients i.e.22.5% of the study population shows evidence of organ failure at presentation.

Distribution of organ failure in different studies are –

48.5 % in MM Correia et al²⁹

11.5 % in Rodolfo L et al³¹

20 % in Murut Kologlu et al²⁸

- ▶ In peritonitis a systemic inflammatory response induced by the peritoneal infection may progress to septic shock and multiorgan failure. The high rate organ failure in our study denotes a delay in presentation of most cases.

PREOPERATIVE DURATION (Table 7)

- ▶ In our study 32 patients i.e. 16 % presented within 24 hours while 168 patients i.e. 84 % presented after 24 hours of onset of the disease
- ▶ In other studies the distribution of preoperative duration is as below-

Study	<24 hrs.	>24 hrs.
Rodolfo L ³¹	49.42%	54.48%
MM Correia ²⁹	34.5%	65.5%

In our institute the cause of delayed presentation i.e. a preoperative duration of peritonitis more than 24 hours was mainly related to the

- ▶ Illiteracy among the study population
- ▶ Lack of proper referral services
- ▶ In some patients the delay was due to diagnostic dilemma which demands early use of more sophisticated investigations like CT scan, which is not available at the peripheral hospitals

PRESENCE OF MALIGNANCY (Table 8)

- ▶ In our study 14 patient’s (7 %) had malignancy. 9 were cases of colonic malignancy with perforation and 3

were of carcinoma stomach with perforation and 2 had a malignancy as an associated finding.

- ▶ In a study by Rodolf L³¹ 2 patients had malignancy.
- ▶ In a study by M.M. Correia²⁹ 89 patients with cancer were studied. Among them 8 were preoperative and all other were postoperative. Chronic use of NSAIDs in patients of malignancies exposes them to an increased risk of perforation.

ORIGIN OF SEPSIS (Table 9)

- ▶ In our study 25 patients i.e. 12.5 % had colonic origin of sepsis while in the rest 175 patients the origin of sepsis was non colonic.
- ▶ In the study by Rudolf L³¹ 12.64% of patient's had colonic origin of sepsis.
- ▶ In the study by Rajendra Singh Jobhta³⁹ 3.76% of patient's had colonic origin of sepsis.
- ▶ The various causes of the perforation of the colon are trauma, diverticulum perforation, perforated malignancy and mesenteric ischaemia.
- ▶ Colonic perforation presents with faecal exudates and a severe form of peritonitis.

TYPE OF PERITONITIS (Table 10)

- ▶ In our study patients 174 i.e. 87% presented with a diffuse form of peritonitis while the remaining 26 i.e. 13 % presented with localized peritonitis.
- ▶ In other study the distribution of type of peritonitis was as below

STUDY	DIFFUSE	
	LOCALISED	
Rajender Jhobta ³⁹	17 %	83 %
Rodolf L ³¹	65.51	34.49 %
Ohmann ¹	34.64 %	65.36 %

- ▶ Diffuse peritonitis is associated with a severe inflammatory reaction and development of sepsis and multiorgan failure.

Localization of peritonitis is body's defense mechanism and will lead to formation of abscess.

NATURE OF EXUDATES (Table 11)

- ▶ In our study 40 patients i.e. 20 % had clear exudates, 124 patients i.e. 62 % had purulent exudates and 36 patients i.e. 18 % had faecal exudates.
- ▶ In a study by Rodolf L³¹ 69.5% has clear exudates and 21.8% had purulent exudates.
- ▶ In a study by Rajender Singh Jhobta³⁹ 15% had clear exudates, 71% had purulent and 13% had faecal exudates.
- ▶ Purulent and faecal exudates are associated with delayed presentation and presence of varying degree of septicaemia.

DISTRIBUTION OF PATIENTS AS MPI CUT OFF POINTS (Table 12)

- ▶ 87 (43.5%) patients had MPI score of less than 21.
- ▶ 70 (35%) patients had MPI score between 21 to 29
- ▶ 43 (21.5%) patients had MPI score greater than 29
- ▶ Of the present prognostic scoring system the Mannheim Peritonitis Index is one of the easiest to apply and the determination of risk is easily available during the initial operation. Retrospective data collection is possible and valid, as only standard information available from the operation report of the patients record is required.
- ▶ In the original study by Wacha and Linder³ the cut off point of 26 MPI point was used. But in our study many patients had attended higher values in the range of 40 (due to presence of malignancy and faecal contamination) so a lower cut off value of 21 MPI point was used so that the sensitivity and the specificity of the study could be increased.

OUTCOME (Table 13)

- ▶ Among the 200 patients studied by us 32 patients died thus placing the mortality at 16%.
- ▶ *Atsushi Hourichi*⁴⁰ in their study of perforation peritonitis had a mortality of 23.1%.
- ▶ *Koperna T*³⁰ et al in their study of secondary bacterial peritonitis had a average total mortality rate of 18.5%.
- ▶ The mortality rate in various studies on perforation peritonitis ranges between 20 to 30%.
- ▶ Thus inspite of improvement in the medical management, availability of new broad spectrum antibiotics and vast development in the field of intensive care with easy availability of intensive care and life support measure the mortality from perforation peritonitis remains high.
- ▶ Development of organ failure and sepsis are important determinants of mortality
- ▶ Therefore research and development should be directed in the understanding of pathogenesis and evolution of these factors so that new and more effective treatment strategies could be evolved.
- ▶ Delay in the presentation for appropriate treatment should be addressed by means of strengthening the referral services and improving the means of transportation.

CORRELATION BETWEEN AGE AND MORTALITY (Table 14 & 15)

- ▶ In our study a total of 119 patients were less than 50 years of age. Out of 119 patients of age less than 50 years 7 (5.9 %) patients died while out of 81 patients with age more than 50 years 25 (30.9 %) patients died
- ▶ In a study by Rodolfo L Braco³¹ the mean age of the survivors was 32.7 years (SD ± 16.64), among non-survivors mean age was 63 years (SD ± 18.94).

Pacelli F et al²³ confirms age as a decisive factor related with mortality. They showed that patients with age of less than 70 years had a mortality rate of 17.2% compared to mortality rate of 37.7% in patients with age more than 70 years.

Ali Yaghoobi Notash et al³⁸ confirms that the risk of in hospital death was higher in patients aged above 60 years.

Kusumoto Yoshiko et al³⁵ in their study of patients operated on for intraabdominal infection found that there was no mortality in less than 50 years age group, while mortality occurring only in patients older than 50 years.

- ▶ Cecilie Svanes¹⁸ et al in their study found that among 581 patients with age < 49, 18 patients died i. e. a mortality of 3.09% , while in patients with age >49 years the mortality was 11.94%.
- ▶ Death and other outcomes of acute surgical illness are uniformly worse in the elderly than in young patients and the adverse impact of age on outcome from abdominal sepsis in particular is well recognized. The higher death rate among the elderly undoubtedly reflects an increased prevalence of pre existing cardiovascular and other diseases as well as a predictable decline in many physiological functions.
- ▶ As patients get older coincident disease are more common. Even if there is no evidence of disease there may be a decrease in the physiological reserve such as the decrease in the glomerular filtration rate despite a normal creatinine. The initial disease that requires surgery may be complicated by tissue hypo perfusion and acidosis from vomiting and loss of fluid into the gastrointestinal tract or bleeding in the elderly population.
- ▶ In our study we confirm that patients over 50 years undergoing emergency surgery for laparotomy have a higher risk of mortality. Mortality after surgery undoubtedly increases with age but this could be because of increased prevalence of comorbid medical conditions in the elderly.

CORRELATION BETWEEN SEX AND MORTALITY (Table 16)

- ▶ In our study total of 136 patients belong to the male sex among which 24 died resulting in a mortality of 17.6 %. Similarly, female sex had a mortality of 12.5 % . & thus female sex has not qualified to be included in the variables of adverse outcome.
- ▶ T M Cook et al²⁹ found out in their study that female sex is one of the parameter associated with death with an odds ratio of 0.21.
- ▶ Yoshiko Kusumoto³⁵ et al found out in their study of 108 patients operated for intra abdominal infections the mortality was 5.3% in men and 15.2% in women
- ▶ In a study by MM Correia²⁹ the factor of female sex has not reached statistical significance between the groups, but it showed a good performance (accuracy of 69.7%) when all MPI components were considered together.

CORRELATION BETWEEN ORGAN FAILURE AND MORTALITY (Table 17)

- ▶ In our study a total of 45 patients showed evidence of organ failure. 30 patients died among this 45 patients thus resulting in a mortality rate of 66.7 %.

- ▶ 2 patients out of 155 patients who showed no evidence of organ failure died resulting in a mortality of 1.3 %.
- ▶ In the study by Rodolfo L et al³¹ 11(6.32 %) patient's died and all of them presented with the variable of organ failure.
- ▶ Daniel A et al²¹ in their study found that the crude relative risk of death in patients with systemic sepsis was 13 times greater than those without. Severe sepsis was present in 424 patients (62%) among the 628 decedents. The author concludes that severe sepsis complicates the course of 11% of all patients with peritonitis.
- ▶ M Hynninen⁴³ et al showed that the degree of organ dysfunction as measured by the SOFA (Sequential Organ Failure Assessment) score was the best predictor for hospital mortality in patients suffering from secondary peritonitis.
- ▶ A systemic inflammatory response induced by the peritoneal infection may further progress to septic shock and multi organ failure.

Organ failure is not an all or none phenomenon, rather it is a continuation of alterations in organ function from normal function, through varying degrees of dysfunction, to organ failure. The description of organ dysfunction needs to be based on simple, easily repeatable variables specific to the organ in question and readily available. Organ dysfunction is not static and it will alter over time.

- ▶ These result mentioned above highlight the importance of early recognition, prevention, and treatment of organ dysfunction in our attempt to improve the short and long term outcome in patients with peritonitis.

CORRELATION BETWEEN PREOPERATIVE DURATION OF PERITONITIS AND MORTALITY (Table 18)

- ▶ In our study out of the 32 patients with a preoperative duration of peritonitis of less than 24 hrs no patient died. Out of the 168 patients who have preoperative duration of peritonitis of more than 24 hrs, 32 patients died thus placing the mortality rate of 19 %.

Ali Yaghoobi Notash³⁸ found mortality of 11.4% in patients presenting within 24 hours of the onset of symptoms while the mortality was 25% in patients presenting late.

In the study by Rodolfo L³¹ all the patients who died were having a preoperative duration of greater than 24 hours.

In the natural history of perforation peritonitis there is a gradual evolution from sepsis to resuscitation, empirical broad spectrum antibiotics and surgical intervention for the clearance of septic debris and control of the source of infection are key in the management of perforation peritonitis.

- ▶ Scapellato S et al suggests that intervention time may be considered the main determinant of mortality in patients with peritonitis, since intervention time is a modifiable prognostic factor while many other factors are not. Therefore in cases of perforation peritonitis after the initial resuscitation of the patient's immediate laparotomy should be done as a surgical emergency.

CORRELATION BETWEEN MALIGNANCY AND OUTCOME (Table 19)

In our study 14 patients had malignancy. 9 out of the 14 patients expired thus placing the mortality rate in presence of malignancy to a whopping 64.3 %.

- ▶ MM Correia et al²⁹ found that in presence of malignancy the mortality rate under the score of 21 was of 33.3% and for score equal to or greater than 21 the mortality rate was 70.6%.
- ▶ Chao- Wen Hsu⁴⁶ in their study of colorectal perforations found out that although the overall mortality was 36.9% the highest disease specific mortality was due to malignancy (61.5%).
- ▶ Peritonitis in oncological patients is generally caused by a ruptured viscous. The classic clinical manifestations are fever, abdominal pain, nausea, vomiting, diffuse abdominal tenderness, rebound tenderness and paralytic ileus. The diagnosis may be delayed by recent postoperative status, immunodepression, concomitant use of antibiotics and advancing age.
- ▶ Peritonitis in oncologic patients presents high mortality rates, essentially related to the severity of the underlying disease.
- ▶ These patients are less prone to survive serious infections.
- ▶ Many disturbances of the immune system have been identified in oncologic patients, such as destruction of the anatomic barriers and derangement in the phagocytic activities and humoral and cellular responses. A consumption of opsonins may occur in the course of severe infection leading to failure of the immune system.

CORRELATION BETWEEN TYPE OF PERITONITIS AND MORTALITY (Table 20)

- ▶ In our study 174 patients had diffuse peritonitis and 26 patients had localized peritonitis.
- ▶ There was no mortality in patients with localized peritonitis while in patients with diffuse peritonitis there were 32 deaths with a mortality of 18.4 %.
- ▶ In the study by Pacelli F²³ generalized peritonitis corresponded to 30.66% of the study group.
- ▶ In the study by Rodolfo L³¹ generalized peritonitis corresponded to 34%.
- ▶ Wahl N and associates⁵⁰ have rated diffuse peritonitis with mortality of 47% as one of the most unfavourable factor. According to them 10 - 15% patients in this group may need a relaparotomy for persistent and recurring infection.
- ▶ As expected the extension of the peritoneal inflammation process was related to increased mortality.

CORRELATION BETWEEN ORIGIN OF SEPSIS (COLONIC / NONCOLONIC) AND MORTALITY (Table 21)

- ▶ In our study 25 patients had colonic origin of sepsis out of which 7 patients died resulting in a mortality of 28% while in non colonic origin of sepsis the mortality rate in our study was 14.3%.

- ▶ Thus according to our study colonic origin of sepsis is associated with poorer prognosis (increased mortality) than the non colonic origin of sepsis. This is in contrast with the MPI as introduced by Wacha and Linder³ where colonic origin of sepsis was considered as a favourable factor.
- ▶ John Bohnen⁵¹ et al in their study of 176 patients found mortality of 10% in appendicitis and duodenal perforation, 50% in peritonitis of intraperitoneal origin other than appendix and the duodenum and 60% in postoperative peritonitis. Thus in this study the significance of the septic focus was high -lighted and it showed that colonic perforation is a higher risk while appendicular and duodenal perforations had a good recovery rate.
- ▶ Chao -Wen Hsu et al⁴⁶ in their study of 141 patients with colorectal perforations found a mortality of 36.9%.

CORRELATION BETWEEN CHARACTER OF EXUDATE AND MORTALITY (Table 22)

- ▶ In our study among the 40 patients with clear exudates 2 (5%) patient's died.
- ▶ 16 (12.9 %) patients died among the 124 patients with purulent exudates
- ▶ 14 (38.9 %) patients died among 36 patients with faecal exudates.
- ▶ Thus the mortality in patients with clear exudates was 5 % purulent exudate was 12.9 % while in faecal exudate the mortality was 38.9 %.
- ▶ In the study of Rodolfo L³¹ clear fluid had a mortality of 5.8% (7/121), purulent fluid had a mortality of 6.3% and faecal fluid had a mortality of 25%.
- ▶ In a study by Chao-Wen-Hsu⁴⁶ in fecal peritonitis the mortality was 57.10% while in purulent peritonitis it was 30.25%.
- ▶ In a study by Christian Ohmann et al² out of 166 patients with clear or purulent exudates 24 (14.45 %) died while out of 188 patients with turbid or feculent exudates 35 (18.61 %) died.
- ▶ In 1983 Killingback⁵² reported a mortality rate of over 70% in case of faecal peritonitis complicating diverticular disease. The mortality rate from purulent peritonitis in the same study was much less than that, between 10 to 30% depending upon coexisting factors such as age, cardio respiratory disease steroid therapy and timing of surgical intervention.
- ▶ The nature of exudates and its mortality has got direct relationship with the amount of micro organism that it contains.
- ▶ Clear exudates are generally sterile to start with so evolution of sepsis is slow.
- ▶ Purulent exudates and fecal exudates had a significant number of microorganisms many of which are gram negative anaerobes and they result in endotoxaemia and septic shock.

MORBIDITY OF PATIENT'S WITH PERITONITIS (Table 23)

- ▶ The duration of hospital stay is good measure of morbidity of patients due to peritonitis.
- ▶ In our study most of the patients i.e. 125 (62.5 %) stay in the hospital for 10-20 days. Very few of patient i.e. 8 (4 %) stay in the hospital for > 30 days.
- ▶ Presence of secondary infections, malnutrition, delayed presentation contribute for longer period of hospital stay and associated increased morbidity in our study population

- ▶ A Billing et al²⁰ in their study of 2003 patients of perforation peritonitis found out a mortality rate of 2.3% in MPI score < 21, in MPI score between 21 and 29 the mortality was 22.5% & it was 51.1% for MPI score greater than 29.
- ▶ Abrar Maqbool Qureshi et al³⁶ in their study found out that for MPI score of less than 21 the mortality was 1.9%,for scores in between 21 - 29 it was 21.9% & for scores 30 or more it was 21.8%.
- ▶ In our study there was no death in patients with MPI score less than 21 ,in MPI score between 21to 29 the mortality was 4.3%.,while in patients with MPI score greater than 29 the mortality was 67.4%.

STATISTICAL VALIDATION OF MANNHEIM PERITONITIS INDEX (Table 24 .25)

- ▶ Rodolfo L et al³¹ in their study found out that 26 MPI point was a useful reference.
- ▶ Patients with >26 points had mortality rate >40% whereas patients having a score <26 did not reach a 3% mortality.

STATISTICAL VALIDATION OF MANNHEIMS PERITONITIS INDEX

AUTHOR	YEAR	SENSITIVITY	SPECIFICITY	PPV	NPV
Billing A.et al. 1 st Series	1994	70	67	-	-
Billing A.et al.3 rd Series	1994	85	61	-	-
Billing A.et al. 4 th Series	1994	69	97	-	-
Billing A.et al. 6 th Series	1994	98	76	-	-
Billing A.et al. 7 th Series	1994	76	58	-	-
Lombordoand et al.	1998	87	88	93	94
Watch et al.	1987	88	90	87	90
Von-Laarhosen et al.	1988	24	35	-	-
Altaca et al.	1992	90	94	-	-
Demmel et al.	1994	89	92	-	-
Corriea M.et al.	2001	87.3	41.2	-	-
Present Study	2011	90.62	91.7	67.44	98.12

- ▶ When considering each risk factor constructing a contingency table in which presence and absence of adverse factor and result (death or survival) are considered the p value allow us to weight In descending order of significance , each of risk factors as follows:
 - a) Presence of organ failure b) Malignancy c) Age > 50 yrs d) Type of exudate e) Duration >24hrs; f) Diffuse / localised peritonitis
 - b) Non colonic origin of sepsis and female sex is also considered as a adverse prognostic factor by Linder and Waccha³ contrary to our study.
 - c) In our study the mortality rate is 28 % for colonic origin of peritonitis and 14.3 % for noncolonic origin of peritonitis. These are statistically not significant with p value of 0.145. Our findings are in agreement with other studies namely John Bohnen⁵¹ et al, Chao –Wen Hsu et al⁴⁶.
 - d) In our study the mortality rate is 12.5 % for female sex and 17.6 % for male sex & was statistically not significant with p value of 0.354, which highlights the fact that female sex is not an adverse prognostic factor, this is not in agreement with the founders of the MANNHEIM PERITONITIS INDEX.

Other studies like Pacelli et al²³ have shown that factors related to host overshadow type and source of infection in evaluation of patients with intra abdominal infection. This is consistent with result of our study.

MICROBIOLOGICAL PROFILE OF ORGANISMS ISOLATED FROM PERITONIAL FLUID IN PATIENT’S WITH PERITONITS (Table 26)

In our study a random sample of 50 patients were drawn and culture reports of peritoneal/drained fluid were analysed, as in all cases microbiological reports were not available in the records. Most common culture result was sterile in 20 (40 %) cases. E.coli was the next common bacteria present in 15 (30%) cases, followed by Klebsiella in 8 (16%) cases, were as pseudomonas and enterococcus was isolated in 6 (12 %) and 1 (2%) cases respectively.

In the study by P. Panhofer, M.Riedl¹⁶ et al(2007), 43 patients with a positive microbiology were investigated ,in which 33 patients (76.7%) had a gram positive microbiology. In the study by A.Prakash, D.Sharma⁽³⁾ et al (2006) found that 42 (50 %) out of total 84 patients had positive peritoneal fluid cultures.

In the study by Berger d et al⁵¹ (1998) found that culture swab taken during operations performed after 24 hours of onset

of symptoms shows no growth, which is consistent with our results.

As per our study we were able to come to the conclusion that all the organisms that were cultured showed a trend to be sensitive to Aminoglycosides (Amikacin) and Cephalosporins (Cefepime with Sulbactam).

VIII. CONCLUSIONS

- ▶ Mannheim Peritonitis index is a useful method to determine study group outcome in patients with peritonitis.
- ▶ All the MPI variables of adverse outcome namely, presence of organ failure; time elapsed > 24hrs; presence of malignancy; age>50 years, generalized extension of peritonitis and type of exudate behaved as expected, except the noncolonic origin of sepsis in peritonitis and female sex.
- ▶ **In our study we found that :**
 - Colonic origin of sepsis was associated with worse outcome probably due to presence of faecal exudates which was more commonly associated with colonic origin of sepsis.
 - Female sex was associated with better outcome as compared to male sex.
 - **Our study differs from MPI in these 2 variables of adverse outcome.**
- ▶ Mortality can be further reduced by early arrival of the patients to hospital and early intervention.
- ▶ Reproducible scoring systems that allow a surgeon to determine the severity of the intra abdominal infections are essential to:
 - 1) Ratify the effectiveness of different treatment regimen.
 - 2) Indicate individual risk to select patient's who may require a more aggressive surgical approach.
 - 3) Inform patient relatives with greater objectivity.
- ▶ In the past 30years, many prognostic scoring system have been developed for critical patients. Presently one of the most accepted score is APACHE II score which integrates various physiological variables during the first 24 hours within the ICU. They are however both complex and time consuming.
- ▶ The MPI is one of the most simple scoring system in use that allows the surgeon to easily determine the outcome risk during initial surgery.
- ▶ Early evaluation of severity of illness using MPI allows us to estimate the probability of patient's survival.
 - ▶ The MPI cutoff points should be adjusted for each hospital on individual basis as in our study it was divided into 3 groups, <21, 21-29, >29.
 - ▶ Death rate in patients with MPI score < 21 was 0%, 21-29 was 4.3% and >29 was 67.4%
 - ▶ The simplicity of MPI makes ideal for hospitals with serious shortages of staff and resources.

Based on our study results we conclude that:

- ▶ MPI is accurate to be used with patients with peritonitis and should be considered reliable and simple reference for estimating their risk of death.

- ▶ **As our study differs in two adverse outcome variables, female sex & noncolonic origin of sepsis, we advocate need for further studies on Mannheim Peritonitis index to include colonic origin of sepsis and to remove female sex as variables of adverse outcome in Mannheim Peritonitis index.**

REFERENCES

- [1] C. Ohmann, prognostic scores and Design of clinical studies, Infection 26 (1998) No. 5.
- [2] Christian Ohmann, Qin Yang, Toni Hau, Prognostic Modelling in Peritonitis. Eur J. Surg 1997; 163 : 53-60.
- [3] Linder MM, Wacha H. The Mannheim peritonitis index. An instrument for the intraoperative prognosis of peritonitis. Chirurg,1987, Feb ; 58 (2) 84-92.
- [4] Deitch EA, multiple organ failure: pathophysiology & potential future therapy. Ann Surg 1992, 216: 117-34.
- [5] Hertzler A.E. The peritoneum. St. Louis: Mosby CV Co; 1919:12.
- [6] James W. Dobbie, Surgical peritonitis: Its Relevance to The pathogenesis of peritonitis in CAPD, peritoneal Dialysis, International Journal of Oral and Maxillofacial Surgery, 31, 206-209Vol.8: pg 241-248: 1998 .
- [7] F Charles Brunicaudi, Schwartz Principles of surgery. 8th Edition.
- [8] Gerard M Doherty, Current surgical diagnosis and treatment. 12th Edition.
- [9] Keith L Moore, Arthur F. Dalley, Clinically oriented anatomy. 5th Edition.
- [10] Sabiston text book of surgery. The biological basis of modern surgical practice. 18th Edition.
- [11] Caroline C. Johnson, James Baldessarre. Peritonitis: Update on pathophysiology, clinical manifestations, and management. Clinical Infectious Disease 1997-24: 1035-47.
- [12] Topely N. Mackenzie RK, Williams JD. Macrophages and Mesothelial cells in bacterial peritonitis. Immunobiology, 1996, Oct.:195 (4-5):563-73.
- [13] Wolfgang Sendit, Rainer Amberg. Secondary peritonitis: Severity of disease and Activation of peritoneal cells. Eur J Surg 2001; 167; 426-432.
- [14] D.H. Witmann, Management of secondary peritonitis, Annals of Surgery 1996, 224;10-18
- [15] A. Prakash, D. Sharma, et al, Effect of Candida infection on outcome in patients with perforation peritonitis; Indian Journal of Gastroenterology may-Jun: 27: 107-109, 2008.
- [16] P. Panhofer, M.Riedl, Clinical outcome and microbial flora in patients with secondary and tertiary peritonitis, Eur Surg (2007) 39/4: 259-264.
- [17] J.L. Dawson. A study of some factors affecting the mortality rate in peritonitis, Gut 1963. 4(4): 368-372.
- [18] Cecilie Svanes M.D. A multifactorial analysis of factors related to lethality after treatment of perforated gastroduodenal ulcer 1935-1985 Ann surgery 1988, 0182.
- [19] Fugger R, Rogy M et al Validation study of the Mannheim peritonitis index. Chirurg. 1988; 59:598-601.
- [20] A Billing, D. Frohlich. Prediction of outcome using the Mannheim peritonitis index in 2003 patients. British Journal of Surgery 1994, 81, 209-213.
- [21] Demmel N, Magg A. The value of clinical parameters for determining the prognosis of peritonitis validation of the mannheim peritonitis index. Langenbecks Arch Chirurg, 1994, 379(3):152-158.
- [22] Liverani A, Correnti SF. The value of 2 distinct prognostic scores in patients with peritonitis. The MPI versus the APACHE II score ,Chirurg. 1990; 61 (4) : 297-300.
- [23] Arch Surgery, Prognosis in intra abdominal infection; Multivariate analysis of 604 patients. 1996, 131 (6): 641-5.

- [24] James M. Watters, The influence of age on the severity of peritonitis. Canadian Journal of surgery 1996; 39; 142-146.
- [25] Bosscha K. Br, Prognostic scoring systems to predict outcome in peritonitis and intra-abdominal sepsis. British J. Surg. 1997 Nov; 84 (11): 1532-34.
- [26] T.M. Cook, C.J.E. Day Hospital mortality after urgent and emergency laparotomy in patients aged 65 yr and over. Risk and prediction of risk using multiple logistic regression analysis. British Journal of Anaesthesia 1998; 80:776-781.
- [27] Sokmen S; Effectiveness of the Mannheim Peritonitis index in patients with peritonitis. Turkish Journal of trauma & emergency surgery. 2001 ; 792 :100-3.
- [28] Murat Kologlu, Validation of MPI and PIA II in two different groups of patients with secondary peritonitis. HepatoGastroenterology 2001;48: 147-151.
- [29] M.M. Correia, Prediction of Death using the Mannheim Peritonitis Index in Oncologic patients. Revista Brasileira de Cancerologia, 2001 47 (1) : 63-68.
- [30] Thomas Koperna et al, Relaparotomy in peritonitis: Prognosis and treatment of patients with persisting intraabdominal infections. World Journal of Surgery. Vol. 24 Number 1, Jan. 2000 page 32-37.
- [31] Rodolfo L. Bracho-Riquelme MC, Men C, Mannheim Peritonitis Index Validation Study at the Hospital General de Durango (Mexico), Cir Ciruj 2002;70:217-225.
- [32] Juan J., Mortality associated with emergency abdominal surgery in the elderly. Can. J. surgery, Vol. 46, No. 2 April 2003.
- [33] Shuhei Komatsu, Prognostic factors and scoring system for survival in colonic perforation. Hepato-Gastroenterology 2005; 52: 761-764.
- [34] Mulari K. Severe secondary peritonitis following gastrointestinal tract perforation. Scand J. Surg. 2004; 93(3) : 204-8.
- [35] Yoshiko Kusumoto, Study of Mannheim peritonitis index to predict outcome of patients with peritonitis. Jpn. Journal Gastroenterological Surg 37; 7-1.
- [36] Abrar Maqbool Qureshi, Predictive power of Mannheim peritonitis index. Journal of College of Physicians and Surgeons of Pakistan 2005 Nov; 15 (11) 693-6.
- [37] Jyrki Tapani Makela, Prognostic factors of perforated sigmoid diverticulitis in the elderly. Digestive Surg. 2005; 22 : 100-106.
- [38] Ali Yoghobi Notash et al. Evaluation of Mannheim peritonitis index and multiple organ failure score in patients with peritonitis. Indian Journal of Gastroenterology 2005; Vol. 25, Issue 5 Pg 197200.
- [39] Rajender Singh Jhobta, Ashok Kumar Attri, Spectrum of perforation peritonitis in India-review of 504 consecutive cases. World Journal of Emergency Surgery 2006, 1:26.
- [40] Atsushi Horiuchi, Evaluation of prognostic factors and scoring system in colonic perforation. World J of gastroenterology 2007. June 21 13 ; (23) 3228-3231.
- [41] Thomas E Rix, Per-operative risk scores for the prediction of outcome in elderly people who require emergency surgery. World Journal of Emergency Surgery 2007, 2: 16.
- [42] Jeffrey Vermeulen, Outcome after emergency surgery for acute perforated diverticulitis in 200 cases. Digestive Surg. 2007; 24:361-366.
- [43] M. Hynninen, Organ dysfunction and long term outcome in secondary peritonitis. Langenbecks Arch Surg (2008) 393:81-86.
- [44] C G Nwigwe, Validation of Mannheim peritonitis index (A Nigerian study) Ebonyl Medical Journal Vol. 6 (1) 2007 pg: 3-8.
- [45] Christian P. Schneider, Prognostic factors in critically III patients suffering from secondary peritonitis: A retrospective, observational, survival time analysis. World J Surg. (2009) 33: 34-43.
- [46] Chao-Wen Hsu, Colorectal perforation: Spectrum of the disease and its mortality. J Soc Colon Rectal Surgeon (Taiwan) September 2007, 81.
- [47] A Mishra, D. Sharma et al, A Simplified scoring system for peptic ulcer perforation in developing countries. Indian Journal of Gastroenterology 2003; 22: 49-53.
- [48] Aijaz A Memon, Spectrum of disease in patients with non-traumatic acute abdomen. World J of Emergency Surgery 2006, 25: 2537-2545.
- [49] Shantanu Kumar Sahu, Amit Gupta. Outcome of secondary peritonitis Based on Apache II score. The Internet Journal of Surgery ISSN : 1528-8242.
- [50] Wahl N, Minkus A.- Prognostically relevant factors in intraabdominal infection, Langenbecks Arch Chir, 1992, 377: 237.
- [51] John Bohnen, Micheline Boulanger- Prognosis in generalized peritonitis, Arch Surg. 1983; 118(3):285-290.
- [52] Killingback M. Diverticular disease, In : Allan RN, Keighley MRB, Eds. Inflammatory bowel diseases, Edinburgh: Churchill Livingstone, 1983: 504-11.

AUTHORS

First Author – Author name, qualifications, associated institute (if any) and email address.

Second Author – Author name, qualifications, associated institute (if any) and email address.

Third Author – Author name, qualifications, associated institute (if any) and email address.

Correspondence Author – Author name, email address, alternate email address (if any), contact number.

Study of Lipoprotein a in Ischemic Stroke Patients

Dr. L. Muralidhar, M.D* ; Dr. D. Sridhar, M.D* ; Dr. G. Balaraju, M.D** ; Dr. Deepika, M.D**

* Asst Prof. of Medicine, Osmania General Hospital, Hyderabad, Telangana State, India.

** Assoc Prof. of Medicine, Osmania General Hospital, Hyderabad, Telangana State, India.

Abstract- Background: Cerebrovascular disease (CVD) and coronary heart disease (CHD) cause 40%–50% of deaths in developed countries with CVD causing 10%–12% of deaths. Though increased Lipoprotein (a) is a risk factor in developing CHD, its role is poorly defined in etiopathogenesis of CVD.

Aims: To find the association of lipoprotein (a) and lipid profile in ischemic stroke patients after acute phase.

Settings and Design: The study was conducted at Osmania Medical College and Hospital, Hyderabad. 50 cases of ischemic stroke and 50 cases of age and sex matched controls were taken for the study. Informed consent was taken from both case and control.

Materials and Methods: Overnight fasting sample was collected from both case and control. Serum was separated and parameters such as total cholesterol, triglycerides, high density lipoproteins-C, low density lipoprotein-C, lipoprotein (a) were estimated.

Conclusion: A statistically positive correlation was found between serum Total cholesterol, Triglycerides, LDL levels and the risk of stroke. Elevated serum Lp(a) is an independent risk factor of ischemic stroke.

Index Terms- Cerebrovascular disease (CVD) and coronary heart disease (CHD), lipoprotein(a) [Lp(a)]

I. INTRODUCTION

The World Health Organization (WHO) definition of stroke is: “rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin”^{1,2}

Studies in subjects with average lipid profiles indicate that raised lipoprotein(a)[Lp(a)] concentrations are associated with myocardial infarction, coronary artery disease, peripheral atherosclerosis and cerebral ischemia. Lipoprotein(a) is considered as an independent risk factor for atherosclerosis. Due to unique structural homology with plasminogen, it interferes with the function of plasminogen thus increasing thrombotic risk. Several studies have evaluated the association between Lp(a) and ischemic stroke. Several cross sectional studies and a few prospective studies provide contradictory findings regarding Lp(a) as a predictor of ischemic stroke. The meager reports available in Indian patients who have different social, living and dietary habits compared to western population, prompted us to undertake this study.

Structure of lipoprotein (a)

Lipoprotein(a) was described in human plasma by Berg as a genetic variant of β -lipoprotein.³

Lp(a) is an LDL like molecule consisting of an apoprotein (apo) B-100 particle attached by a disulphide bridge to apo(a). Apo(a) is a member of a family of “kringle” containing proteins, such as plasminogen, tissue platelet activator (tPA), prothrombin, factor XII, and macrophage stimulating factor (MSF).^{4,5} Lp(a) shares a high degree of sequence identity with plasminogen.^{4,6}

Modulation of plasma Lp(a) concentrations:

Lp(a) values can be increased as part of the acute phase response, and in diabetes mellitus,²⁸ chronic renal failure,²⁹ nephrotic syndrome,³² cancer, menopause, and hypothyroidism.³⁵

Lp(a) values are decreased in liver failure³⁷ and hyperthyroidism. Furthermore, nicotinic acid, tamoxifen, oestrogens,⁴¹ progesterone, and anabolic steroids might decrease Lp(a) concentrations. Fibrates have been shown, in some studies, to reduce Lp(a) concentrations,⁴³ whereas statins might increase Lp(a) concentrations.

The pathophysiological link between Lp(a) and atherothrombosis:

The accumulation of Lp(a) molecules has been demonstrated in the arterial walls of human coronary and cerebral vessels.¹⁴ This process might be attributed to the tendency of apo(a) to bind to connective tissue elements, such as proteoglycans, glycosaminoglycans, and, specially, fibronectin.¹⁵

Because of the structural homology with plasminogen, Lp(a) has important antithrombotic properties, which could contribute to the pathogenesis of atherothrombotic disease. Lp(a) binding to immobilized fibrinogen and fibrin results in the inhibition of plasminogen binding to these substrates. In addition, Lp(a) competes with plasminogen for its receptors on endothelial cells, leading to diminished plasmin formation, thereby delaying clot lysis and favouring thrombosis.⁵⁵

The presence of oxidized phospholipids in Lp(a), potentially being taken up by the vessel wall, could also accelerate development of atherosclerosis.

The optimal level should be no greater than 20 mg/dl, especially in Indian population⁶¹

Aims and objective of study:

The aim of this study is to determine the role of lipoprotein (a) as a marker for ischemic stroke

Material and methods:

The present study, serum lipoprotein (a) levels as a risk factor for ischemic stroke, was conducted in the Department of General Medicine, Osmania General Hospital, Hyderabad for a period of two years from October 2011-October 2013

Study design: Case Control Study

In this study, 50 patients who are survivors of ischemic non cardioembolic stroke with history of sudden onset focal neurological deficit persisting beyond 24 hours were included.

II. SELECTION OF CASES

Diagnosis of ischemic stroke was based on the following criteria:

- Clinical evidence of ischemic stroke
- Cranial computed tomography (CT) scan or magnetic resonance imaging (MRI) consistent with ischemic stroke
- Absence of major predisposing factors to cardiogenic stroke including atrial fibrillation, valvular heart disease, prosthetic heart valves, endocarditis, acute myocardial infarction, dilated cardiomyopathy or ventricular aneurysm.

III. EXCLUSION CRITERIA

- Patients with CT / MRI scan showing intracerebral hemorrhage, tumor, or other mass lesion
- History of head injury
- Patients with coronary artery disease (including asymptomatic patients with electrocardiographic evidence of previous myocardial infarction)
- patients with vasculitis
- Patients with liver, renal, or thyroid disease
- Patients taking drugs which may alter lipid and lipoprotein profiles
- Women on contraceptive pills
- Sepsis
- Malignancy
- Active collagen vascular disease

50 age and sex matched healthy subjects were used as controls. Exclusion criteria were applicable even to the control subjects. All patients were subjected to a detailed history, general physical examination, a detailed neurological examination. History regarding risk factors such as age, sex, hypertension, diabetes mellitus, cardiovascular history, drug history, smoking habits, alcohol intake, family history etc was elicited.

A patient was considered as hypertensive when the patient is already on treatment with antihypertensive drugs or, in accordance with the definition by the Joint National Committee (JNC), when systolic and diastolic blood pressures were ≥ 140 mm Hg and ≥ 90 mm Hg respectively.

A subject was defined as affected by diabetes mellitus if the patient is already on treatment or, according to American Diabetes Association definitions, if fasting glucose in serum was ≥ 126 mg/dl or random blood glucose was ≥ 200 mg/dl with symptoms, or HbA1 C $\geq 6.5\%$

A subject was considered as having dyslipidemia if the patient is already on specific medication or, according to ATP III definition if total cholesterol levels were ≥ 200 mg/dl or triglyceride levels were ≥ 150 mg/dl or LDL levels were > 100 mg/dl or HDL levels were < 40 mg/dl.

Written approval of ethical committee, following the national guidelines was taken before the initiation of study. Blood samples were collected after 21 days of occurrence of stroke. Overnight fasting blood samples were collected without adding anticoagulant to the tube not less than three weeks after the occurrence of stroke, because Lp(a) levels are known to get altered due to acute phase response.

The following investigations were performed in each case:

Complete hemogram - Hemoglobin, Total leucocyte count, differential leucocyte count, ESR, Platelet count ; **Complete urine examination** - **Blood sugar**, Fasting(mg/dl), Postprandial(mg/dl), Random(mg/dl) ; **Renal function tests** - Serum urea(mg/dl), Serum creatinine(mg/dl), serum electrolytes(sodium, potassium in mmol/l) ; ECG; Echocardiography ; X Ray Chest ; CT brain ; MRI brain(whenever required), Plasma lipoprotein (a) levels; **Lipid profile** - Total cholesterol, Serum triglycerides, LDL cholesterol, HDL cholesterol.

Lp(a) estimation is done through nephelometric assay. Nephelometry is a technique for estimation of number and size of particles in a suspension by measurement of light scattered from a beam of light passed through the solution by a nephelometer. Lp(a) can also be estimated by Radio Immune Assay, Rosache strips using micro ELISA, Monoclonal antibodies. Expected normal range : < 30 mg/dl

IV. RESULTS

The present study "Serum lipoprotein(a) levels as a risk factor of ischemic stroke" was conducted on fifty patients of cerebrovascular accidents of ischemic type admitted in the emergency department and wards of the General Medicine department, Osmania General hospital, Hyderabad. Fifty healthy age and sex matched subjects were recruited as controls.

Observations based on history, general examination and systemic examination were made on the same proforma. Serum lipoprotein(a) levels along with other investigations were also assessed as per proforma.

Statistical analysis was done using the Pearson Chi Square test. The data was analyzed systematically and observations are presented are follows:

AGE DISTRIBUTION

The mean age in cases was 54.38 years with a S.D of 12.35. The mean age in controls was 52.9 years with a S.D of 11.34. Thus, the cases and controls were comparable in respect to age.

GENDER DISTRIBUTION ; Male female ratio is 1.17 among the cases and 1.5 in controls.

COMPARISON OF RISK FACTORS IN CASES AND CONTROLS - Table 1

Risk factors		Cases		Controls	
		Yes	No	Yes	No
1	Hypertension	36	14	30	20
2	Diabetes	32	18	28	22
3	smoking	22	28	20	30
4	Alcohol	30	20	26	24
5	Obesity	30	20	19	31
6	Family history	3	47	0	50

Hypertension Distribution

- Hypertensive patients are 36 and 30 in cases and controls respectively.
- On further statistical analysis, this variable was not found to be statistically significant(p=0.205)

Diabetes Mellitus Distribution

- Diabetic patients are 32 and 28 in cases and controls respectively.
- Statistical analysis showed that this variable is statistically insignificant (p=0.413)

Smoking Distribution

- Smokers are 22 ,20 in cases and controls respectively.

- Further analysis shows that this variable is statistically insignificant (p=0.685)

Alcohol Distribution

- Alcoholics are 30 and 26 in cases and controls respectively.
- Further analysis did not reveal significant relation between alcoholism and stroke(p=0.420)

Obesity Distribution

- Obese patients are 30 and 19 in cases and controls respectively.
- On further analysis, the difference was found to be statistically significant(p=0.027)

Total Cholesterol Distribution - Table 2

	No. of cases	Mean cholesterol	Standard deviation	p value
Cases	50	193.52	38.99	0.435
Controls	50	187.3	40.50	

- On further analysis, this was not found to be statistically significant (p=0.435)

Triglyceride (TG) Distribution - Table 3

	No. of cases	Mean level triglyceride	Standard deviation	p value
Cases	50	138.06	35.44	0.0894
controls	50	124.6	42.68	

- Statistical analysis showed that this was insignificant (p=0.0894)

LDL Cholesterol Distribution - Table 4

	No. of cases	Mean LDL levels	Standard deviation	p value
Cases	50	104.74	27.30	0.032
Controls	50	91.96	31.38	

- On further analysis, it was found that LDL cholesterol is statistically significant in relation to ischemic stroke (p= 0.032)

HDL Cholesterol Distribution - Table 5

	No. of cases	Mean HDL levels	Standard deviation	p value
Cases	50	52.02	13.374	0.4705
Controls	50	50.3	10.150	

- Further statistical analysis showed that this variable was statistically insignificant (p=0.470)

Lipoprotein (a) Distribution

Lipoprotein(a) level distribution found in cases and controls in this study is depicted in table 6 and table 7

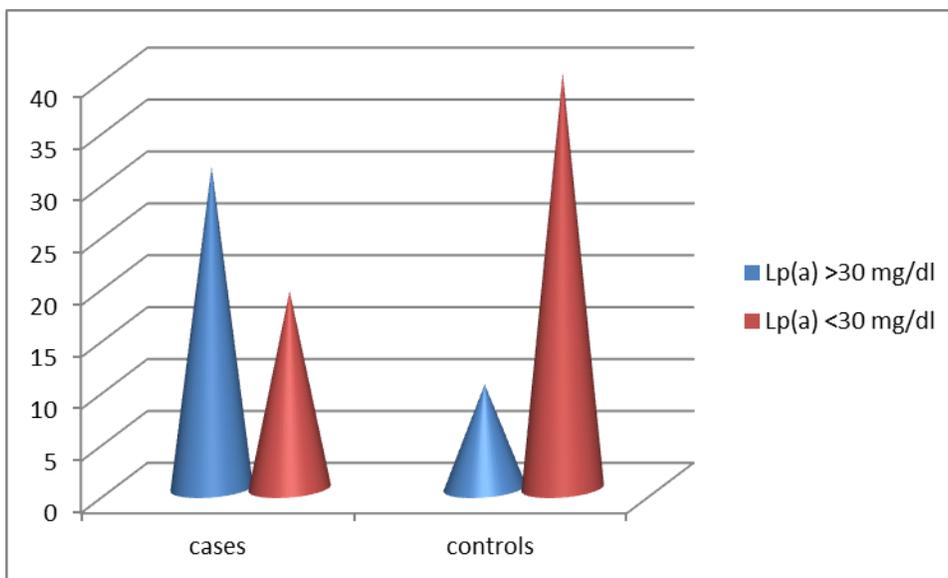
Table 6

Lp(a) levels	Cases	Controls	Total
>30 mg/dl	31(62%)	10(20%)	41(41%)
<30 mg/dl	19(38%)	40(80%)	59 (59%)
Total	50 (100%)	50(100%)	100 (100%)

Table 7

	No. of cases	Mean Lp(a) levels	Standard deviation	p value
Cases	50	34.664	12.76	0.005
Controls	50	28.084	10.118	

- 31 cases and 10 control subjects enrolled in this study had Lp(a) levels >30 mg/dl.
- 19 cases and 40 control subjects had normal values <30 mg/dl



On further analysis, this variable was found to be statistically significant($p=0.005$).

V. DISCUSSION

This study, which was a case control study, was conducted in the Osmania General Hospital, in the Department of General Medicine, for a period of 2 years during which 50 cases of ischemic stroke and 50 controls were studied.

In the present study there are 36(72%) hypertensives and 14(28%) normotensives among cases. Among controls 30(60%) were hypertensives and 20(40%) were normotensives. Analysis revealed p value of 0.205. Therefore, there is no significant relation between systemic hypertension and stroke. These results are consistent with studies of Zenker et al¹⁸ and Van kooten et al¹⁹

In the present study there were 32(64%) diabetic patients among cases whereas 18(36%) were non-diabetics. Among controls 28(56%) were diabetics and 22(44%) were non-diabetics. Analysis showed p value = 0.413(Not significant). Therefore, there is no significant relation between diabetes and stroke.

The mean Lp(a) levels in a study done by Marques et al in 2004²⁰ in 26 type 2 Diabetes Mellitus and 34 non diabetics with ischemic stroke were both statistically significant. The mean Lp(a) levels in diabetics was 29.49 mg/dl +/- 23.09 and in non diabetics was 44.81 mg/dl +/- 44.34 with a p value of 0.115, indicating that Lp(a) levels are a risk factor independent of the diabetes status of the individual. Similar results were seen in our study.

In the present case control study, 50 cases of ischemic stroke had a mean plasma lipoprotein(a) value of 34.664 mg/dl with a S.D of 12.76. This was statistically significantly higher than mean lipoprotein(a) concentration (28.084mg/dl with S.D of 10.118) in healthy controls. This indicates that serum lipoprotein(a) levels are a risk factor for ischemic stroke

Shintani et al²¹ evaluated 54 patients with cerebral infarction to evaluate the role of lipoprotein(a) in ischemic stroke. When patients with atrial fibrillation were excluded to omit cardiac

embolic strokes from analysis, the group consisted of 45 patients. The mean lipoprotein(a) levels in the study were 25 mg/dl with a S.D of 21 and p value of <0.025.

Nagayama et al²² evaluated 101 serum lipoprotein(a) levels in 101 patients with ischemic stroke and 37 normal control subjects, taking the clinical profiles into consideration. The mean lipoprotein (a) levels were 40.2 mg/dl with a S.D of 20.1 and p value of <0.01.

Jurgens et al²³ in 1995 analyzed serum lipoprotein (a) levels and other lipid parameters in 265 patients with ischemic cerebrovascular disease. The mean lipoprotein(a) level was 40.2 mg/dl with a S.D of 31.8. the p value was found to be statistically significant ($p<0.001$)

In all the above studies, the mean lipoprotein(a) levels were greater than 30 mg/dl except in the study done by Shintani et al, but even in this study the relation between high levels of lipoprotein (a) and ischemic stroke was statistically significant.

Study	No. of cases	Mean Lp(a)	p value
Jurgens et al	265	41.1 +/- 31.8	<0.001
Nagayama et al	101	40.2 +/- 20.1	<0.01
Shintani et al	45	25 +/- 21	<0.025
Our study	50	34.6 +/- 12.7	0.005

Jurgens et al²³, in their study on lipoprotein (a) and other lipid factors on ischemic vascular disease found significant correlation between LDL cholesterol and ischemic stroke. Similar observation was made in our study (LDL cholesterol $p=0.032$)

Our study showed the role of obesity as an independent risk factor in ischemic stroke. There is some controversy about the effect of obesity on Lp(a). In a study conducted by James Corsetti et al²⁴, lipoprotein(a) concentrations were not influenced by obesity, visceral fat content, or weight loss after a very low energy diet. However, there is also some evidence that obese individuals have higher Lp(a) values and that weight loss (by diet or surgical intervention) is associated with a significant reduction in these values. The mechanism(s) responsible for these changes remains to be defined.

Our study did not reveal significant relation between total cholesterol and ischemic stroke. This is consistent with the studies conducted by Lindgren et al²⁵, Zenker et al²⁶, which showed no correlation between total cholesterol and stroke.

In Atherosclerosis Risk In Communities (ARIC) study conducted by Ohira et al²⁷ in 2006 in 14221 subjects for a period of 13.5 years, it was showed that high lipoprotein (a) concentration is associated with a higher incidence of ischemic stroke in blacks and white women, but not in white men. Further studies are needed in Indian population to establish this difference in racial and ethnic groups.

Hoque MM et al²⁸ conducted a case control study to evaluate the lipoprotein(a) as a risk factor for CVD (cerebrovascular disease). Subjects were grouped as group-I (30, healthy control), Group-II (60, Hemorrhagic CVD) and group-III (60, Ischemic CVD). Fasting (12 hr) blood samples were collected from all subjects and in CVD cases samples were collected after 24 hr of attack. Lipid profile and Lp(a) conc. were measured in all samples. Mean serum Lp(a) concentration in Group-I, Group-II and Group-III were found to be 17.6 +/- 7.4 mg/dl, 31.9 +/- 15.6 mg/dl and 44.8 +/- 24.0 mg/dl respectively. Both the groups of CVD cases showed significantly higher level of serum Lp(a) concentration compared to healthy control. CVD cases did not differ statistically in respect of their lipid profile when compared with control. Moreover the serum Lp(a) concentration of CVD cases found to show no correlation with their lipid profile, suggesting the serum Lp(a) concentration a possible independent risk factor for CVD.

Findings of the present study run in parallel with the above authors. The results of our study indicate that high lipoprotein (a) levels are an independent risk factor for ischemic stroke and thus the need to find methods for its prevention and management.

VI. SUMMARY

The present conventional risk factors are unable to explain this emerging epidemic of cerebrovascular disease, hence the search for new, modifiable, preventable and treatable risk factors is necessary. Among them, the relation between stroke and anti oxidant deficiencies, raised homocysteine, selenium and low plasma ascorbic acid levels has received considerable attention. Four decades of research on lipoprotein(a) have seen it emerge as a clinically important molecule. Evidence has been gained for Lp(a) involvement in the development of CHD to a point where routine measurement of Lp(a) in patients at risk must be recommended. Further, except nicotinic acid which in very large, usually intolerable doses decreases Lp(a) levels, no other drug is found to be effective. Hence, it is imperative to strictly control additional risk factors in individuals with elevated Lp(a).

The present study was conducted with the aim to study lipoprotein(a) with reference to ischemic stroke. This study, which was a case control study, was conducted in department of General Medicine, Osmania General Hospital, Hyderabad. It included 50 ischemic stroke patients who were compared with age and sex matched controls during a period of two years.

After evaluating the findings for statistical significance, it is concluded from our study that the mean +/- S.D concentration of serum Lp(a) was significantly higher than that of controls. The present study proved a significant correlation between elevated serum Lp(a) and ischemic stroke (p=0.005). Obesity and elevated LDL were also found to be significant risk factors of ischemic stroke.

VII. CONCLUSION

1. Elevated serum Lp(a) is an independent risk factor of ischemic stroke.
2. Reducing the circulating values of Lp(a) might prove difficult. It is imperative to control additional risk factors in individuals with elevated lipoprotein(a).
3. Measurement of serum Lp(a) as a screening tool for the risk of vascular events should be considered in patients with various known risk factors.

REFERENCES

- [1] Harrison's principles of internal medicine.2012; 18th edition, volume 2: 3270
- [2] WHO MONICA Project Investigators. The World Health Organization MONICA Project (Monitoring trends and determinants in Cardiovascular Disease) J Clin Epidemiol 41, 105-114. 1988
- [3] Berg, K. A new serum type system in man—the Lp System. Acta Pathol. Microbiol. Scand., 1963, 59, 369-382.
- [4] Huby T, Chapman J, Thillet J. Pathophysiological implication of the structural domains of lipoprotein(a). Atherosclerosis 1997;133:1-6.
- [5] Ikeo K, Takahashi K, Gojobori T. Different evolutionary histories of kringle and protease domains in serine proteases: a typical example of domain evolution. J Mol Evol 1995;40:331-6.
- [6] McLean JW, Tomlinson JE, Kuang WJ, et al. cDNA sequence of human lipoprotein(a) is homologous to plasminogen. Nature 1987;330:132-7
- [7] Bruckert E, Davidoff P, Grimaldi A, et al. Increased serum levels of lipoprotein(a) in diabetes mellitus and their reduction with glycemic control. JAMA 1990;263:35-6.
- [8] Kronenberg F, Koenig P, Neyer U, et al. Multicenter study of lipoprotein(a) and apolipoprotein(a) phenotypes in patients with end-stage renal disease treated by hemodialysis or continuous ambulatory peritoneal dialysis. J Am Soc Nephrol 1995;6:110-20.
- [9] Stevingel P, Berglund L, Heimbueger O, et al. Lipoprotein(a) in nephrotic syndrome. Kidney Int 1993;44:1116-23.
- [10] Engler H, Riesen W. Effect of thyroid function on concentration of lipoprotein(a). Clin Chem 1993;39:2466-9.
- [11] Feely J, Barry M, Keeling PWN, et al. Lipoprotein(a) in cirrhosis. BMJ 1992;304:545-6.
- [12] Farish E, Spowart K, Barnes JF, et al. Effects of postmenopausal hormone replacement therapy on lipoproteins including lipoprotein(a) and LDL subfractions. Atherosclerosis 1996;126:77-84.
- [13] Maggi FM, Poglionica MR, De Michele L, et al. Bezafibrate lowers elevated plasma levels of fibrinogen and lipoprotein (a) in patients with type IIa and IIb dyslipoproteinaemia. Nutr Metab Cardiovasc Dis 1994;4:215-20.

- [14] Rath M, Niedorf A, Rablin T, et al. Detection and quantification of lipoprotein(a) in the arterial wall of 107 coronary bypass patients. *Arteriosclerosis* 1989;9:579-92.
- [15] Kostner GM, Bihara Varga M. Is atherogenicity of Lp(a) caused by its reactivity with proteoglycans? *Eur Heart J* 1990;11(suppl E):184-9.
- [16] Aznar J, Estelles A, Breto M, et al. Euglobulin clot lysis induced by tissue type plasminogen activator in subjects with increased levels and different isoforms of lipoprotein(a). *Thromb Res* 1993;72:459-65.
- [17] Clinical implications: Dyslipidemia in the Asian Indian population. 20th Annual Convention of the American Association of Physicians of Indian origin held in Chicago in 2002.
- [18] Ranga, G. S.; Kalra, O. P.; Tandon, H.; Gambhir, J. K.; Mehrotra, G. Effect of aspirin on lipoprotein(a) in patients with ischemic stroke. *J. Stroke Cerebrovasc. Dis.*, 2007, 16(5), 220-224.
- [19] Van Kooten F, van Krimpen J, Dippel DW, et al. Lipoprotein(a) in patients with acute cerebral ischemia. *Stroke* 1996;27:1231-5.
- [20] Maurus MAH, Rosalia GF, Maria Jose CC, Rodrigo VCLA, Jose Alberto GS. Plasma lipoprotein(a) levels – a comparison between diabetic and non diabetic patients with acute ischemic stroke. *Arq Neuropsiquiatr* 2004; 62(2- A): 233-236.
- [21] Shuzo Shintani, Shuichi Kikuchi, Hideo Hamaguchi, Tatsuo Shiigai. High serum lipoprotein(a) levels are an independent risk factor for cerebral infarction. *Stroke* 1993; 24: 965-969.
- [22] Nagayama M, Shinohara Y, Nagayama T. Lipoprotein(a) and ischemic cerebrovascular disease in young adults. *Stroke* 1994; 25: 74-78.
- [23] Jurgens G, Wendy CTP, Koltringer P, Walter P, Qi Chen, Greilberger J, Paul FM, Bryan TB, Andrew GS, Janet HR. Lipoprotein (a) serum concentration and apolipoprotein (a) phenotype correlate with severity and presence of ischemic cerebrovascular disease. *Stroke* 1995; 26: 1841-1848.
- [24] James P. Corsetti, Judith A. Sterry, Janet D. Sparks, Charles E. Sparks, and Michael Weintraub. Effect of Weight Loss on Serum lipoprotein(a) Concentrations in an Obese Population. *Clin.Chem.*37/7, 1191-1195 (1991)
- [25] Lindgren A, Nilsson-Ehle P, Norrving B, et al. Plasma lipids and lipoproteins in subtypes of stroke. *Acta Neurol Scand* 1992;86:572-8.
- [26] Zenker G, Koltringer P, Bone G, Niederkorn K, Pfeiffer K, Jurgens G. Lp(a) as a strong indicator for cerebrovascular disease. *Stroke* 1986; 17: 942-945.
- [27] Tetsuya O, Schreiner PJ, Morrisett JD, Liyod EC, Wayne DR, Folsom AR. Lipoprotein(a) and incident ischemic stroke. *Stroke* 2006; 37: 1407.
- [28] Hoque MM, Sultana P, Arslan MI. Lipoprotein(a)- an independent risk factor for CVD. *Mymensingh Med J.* 2005 Jul; 14(2):136-4

AUTHORS

First Author – Dr. L. Muralidhar, M.D., Asst Prof. of Medicine, Osmania General Hospital, Hyderabad, Telangana State, India.

Second Author – Dr. D. Sridhar, M.D., Asst. Prof. of Medicine, Osmania General Hospital, Hyderabad, Telangana State, India.

Third Author – Dr. G. Balaraju, M.D., Assoc. Prof. of Medicine, Osmania General Hospital, Hyderabad, Telangana State, India.

Fourth Author – Dr. Deepika, M.D., Osmania General Hospital, Hyderabad, Telangana State, India.

Power factor profile of NiO

Smita Jain, Dr. Purnima Swarup

Department of physics UIT, RGPV BHOPAL MP (INDIA)

Abstract- This paper is providing the power factor profile of undoped bulk Nickel Oxide. Nickel oxide is a transition metal oxide having many interesting properties and also has application in various fields such as thermoelectric power generation. In thermoelectric power generation the efficiency of the material is depend upon the figure of merit (ZT) of the used material. Figure of merit of the material is expressed as $ZT = (S^2\sigma/k) T$ where $S^2\sigma$ is known as power factor and k is the thermal conductivity of the material. Thus in this paper we have analyze the power factor of the nickel oxide at different temperature ranges and with the help of this we can find out the figure of merit.

Index Terms- power factor, figure of merit, thermoelectric material, electrical conductivity, thermo power etc.

I. INTRODUCTION

Thermoelectric power generation has become an attractive area for the researchers due to huge requirement of energy and waste heat recovery. Our present work is also concentrated in this area with material NiO. High performance thermoelectric devices made by thermoelectric material having high seeback coefficient, high electrical conductivity and low thermal conductivity. Existing materials which are used for the thermoelectric conversion such as Bi_2Te_3 , SbTe or PbTe are efficient but these are not works at high temperatures (above $600\text{-}800^\circ\text{C}$) and toxic also. [1] NiO is non toxic material and works efficiently up to very high temperatures these properties make it favorable for thermoelectric power generation.

Thermoelectric power generation depends upon the figure of merit of the material $ZT = (S^2 * \sigma / k) T$, where s is the seeback coefficient, σ is the electrical conductivity and k is the thermal conductivity. This figure of merit is directly proportional of the factor $S^2 * \sigma$ which is known as the power factor of the material. [3] In this paper we studied the power factor of the NiO sample at the different temperatures and analyzed the data with the help of graph plotted between temperature and power factor $S^2 * \sigma$.

II. METHODOLOGY

As per the recorded data for undoped NiO by Keem et al [4], we calculated some of the other parameters such as power factor and figure of merit at different temperatures. All the given data provided us the bulk characteristics of NiO up to the temperature range 700 K. For the above purpose the used formula is

$$\text{Power factor} = S^2 * \sigma$$

$$\text{Figure of merit } ZT = (S^2 * \sigma / k) T$$

III. RESULTS AND DISCUSSION

Between the temperature ranges 300 -800 K we have some of the values of seeback coefficient, thermal conductivity and electrical conductivity of undoped NiO. With the help of this data we can calculate the power factor of the NiO sample at the given temperature range. [4]

TABLE: I

T (K)	S(mV/K)	k	S^2	$\sigma(\Omega^{-1}\text{cm}^{-1})$	$S^2 * \sigma$ ($\text{mWcm}^{-1}\text{K}^{-2}$)	$ZT = (S^2 * \sigma / k) T$
300	0.982	.202	0.964	0.0012	0.00156	.0077
400	0.797	.115	0.635	0.0026	0.00165	.0143
440	0.733	.108	0.537	0.011	0.0059	.0546
500	0.671	.078	0.45	0.049	0.022	.282
570	0.609	0.062	0.37	0.138	0.051	0.822
670	0.549	.045	0.299	0.303	0.09	2

700	0.475	.026	0.225	0.432	0.097	3.73
770	0.412	.020	0.169	0.504	0.085	4.25
800	0.375	.012	0.14	0.52	0.072	6

On the basis of above calculation we draw a graph between temperature and power factor which gives us information regarding efficiency of the undoped NiO material up to certain temperatures.

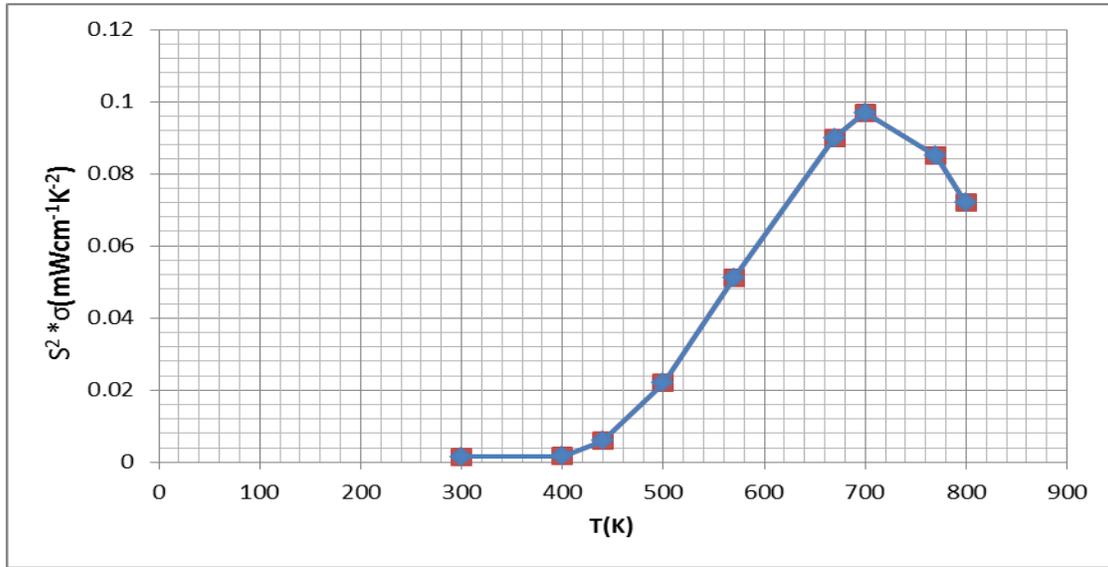


Fig. 1 Analyzing the graph we can conclude that at the temperature below 800K the power factor of the undoped nickel oxide is increases and above the 700K it decreases.

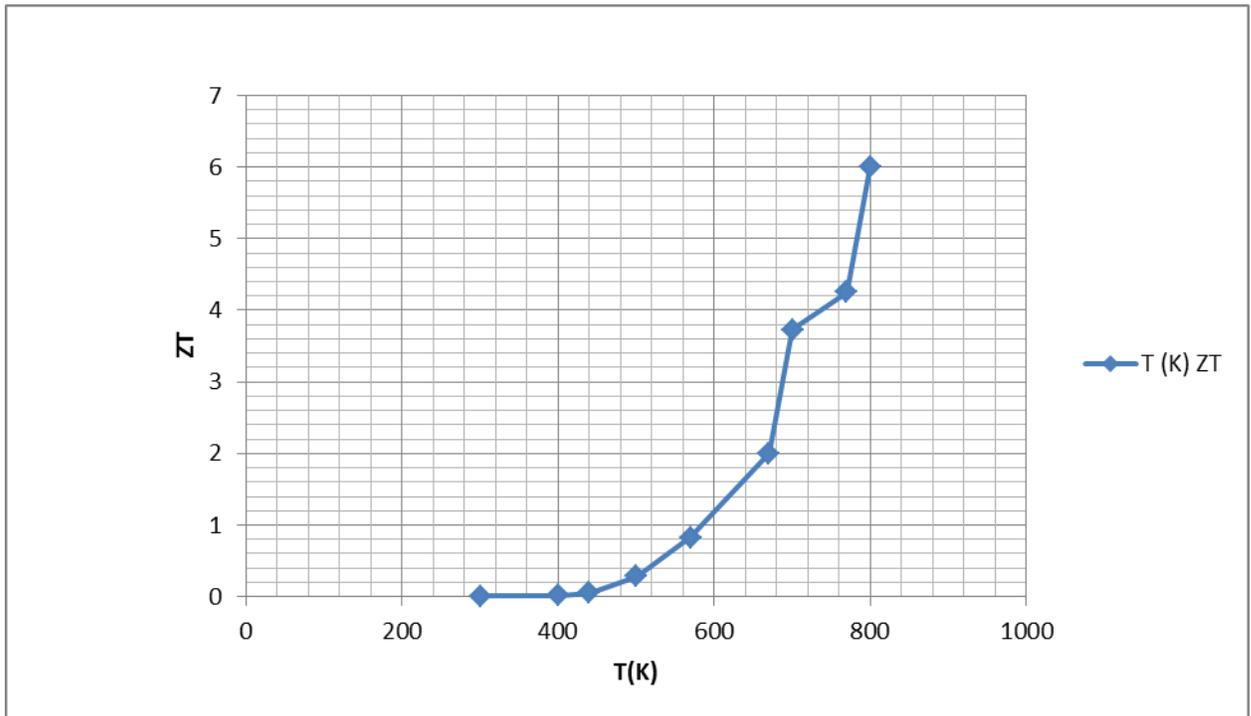


Fig. 2 analyzing the fig 2 we can say that as the temperature increases figure of merit of the NiO also increases because the thermal conductivity of NiO is decreases.

IV. CONCLUSION

By the above calculated data of the undoped NiO we can find out the increasing power factor up to 670K. After that it can decrease so for the better performing devices we must enhance the power factor of the NiO with the help of doping with some effective highly conductive material so we can get the good results for more applications.[5] on the other hand if the thermal conductivity is decreases figure of merit of the material increases weather the power factor increases or not. But major role play of power factor restricted us, thus we must enhance the power factor of the NiO with doping tool either by transition metal ions or metal having rare lattice defects.[6-7]one more fact is that the semiconductors are good thermoelectric materials and when we reduces the dimensions of the NiO at the nanoscale it turns to p type semiconducting material having indirect band gap. So we can use this material for the better performing thermoelectric devices.

REFERENCES

- [1] shin nishiyama,takahiro ushijima. 1-33 yayoi,inage-ku chiba 263-8522,japan, TENDENCIES OF P-TYPE THERMOELECTRIC OXIDE SEMICONDUCTOR

- [2] STRUCTURAL AND ELECTRICAL PROPERTIES OF ANNEALED NICKEL OXIDE (NiO) THIN FILMS PREPARED BY CHEMICAL BATH DEPOSITION, Journal of Ovonic Research ,Vol. 9, No. 1, January – February 2013, p. 9 – 15
- [3] HIGH PERFORMANCE P-TYPE THERMOELECTRIC OXIDE BASED ON NiO. Materials Letters 45,2000. 302–306
- [4] E. Keem and J. M Honi-g, SELECTED ELECTRICAL AND THERMAL PROPERTIES OF UNDOPED NICKEL OXIDE.
- [5] P. Mallick¹, N. C. Mishra², EVOLUATION OF STRUCTURE, MICROSTRUCTURE, ELECTRIC AND MAGNETIC PROPERTIES OF NICKLE OXIDE (NiO) WITH TRANSITION METAL DOPING. American Journal of Materials Science 2012, 2(3): 66-71 DOI: 10.5923/j.materials.20120203.06
- [6] Wei-Luen Jang a, Yang-Ming Lub, Weng-Sing Hwang a, Wei-Chien Chena, ELECTRICAL PROPERTIES OF Li DOPED NiO FILMS Journal of the European Ceramic Society 30 (2010) 503–508
- [7] Joo-Hyoung Lee,^{1,4} Junqiao Wu,^{1,2,3} and Jeffrey C. Grossman, ENHANCING THE THERMOELECTRIC POWER FACTOR WITH HIGHLY MISMATCHED ISOELECTRONIC DOPING.PRL 104, 016602 (2010) physical review letters 8 January 2010

AUTHORS

First Author – Smita Jain, M.Sc. (Physics), UIT RGPV Bhopal
E-mail-Jain.mini0809@gmail.com

Second Author – Dr.Purnima Swarup Khare Ph.D., UIT RGPV,
Bhopal E-mail-purnimaswarup@hotmail.com

Life and Diabetes

P. Thenmozhi

M.Sc., M.A., M.Phil., Associate Professor & Head, Department Of Home Science, Seethalakshmi Ramaswami College, Tiruchirappalli - 620 002.

Abstract- Life is precious. All should live happily. For that people must know preventive measures to lead a healthy life without any disorder. People should take balanced diet. Diabetes mellitus is a chronic disease of mankind throughout the world. General observation shows that lifespan of people with diabetes mellitus is better than other condition. Until European settlement of Australia 200 years ago, Aborigines lived as nomadic hunter-gatherers all over the continent under widely varying geographic and climatic conditions. Successful survival depended on a comprehensive knowledge of the flora and fauna of their territory. Available data suggest that they were physically fit and lean, and consumed a varied diet in which animal foods were a major component. Traditional methods of food preparation (usually baked whole or eaten raw) ensured maximum retention of nutrients. In general, traditional foods had a low energy density but high density of some nutrients. The Indian diet of the last century was much higher in carbohydrate and lower in fat compared with the modern-day diet. Any changes that this diabetes-prone population can make toward their traditional diet may help to decrease their incidence of diabetes. Mushroom also countered the initial reduction in plasma [insulin](#) and the reduction in pancreatic [insulin](#) concentration, and improved the hypoglycemic effect of exogenous [insulin](#). Traditional treatments have mostly disappeared in occidental societies, but some are prescribed by practitioners of alternative medicine or taken by patients as supplements to conventional therapy. However, plant remedies are the mainstay of treatment in

underdeveloped regions. A hypoglycemic action from some treatments has been confirmed in animal models and non-insulin-dependent diabetic patients, and various hypoglycemic compounds have been identified. A botanical substitute for insulin seems unlikely, but traditional treatments may provide valuable clues for the development of new oral hypoglycemic agents and simple dietary adjuncts.

Index Terms- Gooddiet , Diabetes free life, Diet for diabetes.

I. INTRODUCTION

Living with diabetes can be challenging, but you can still lead a near normal life. [Diet](#) and lifestyle are key components in living healthily with diabetes. Living with diabetes includes a plethora of information pages about the kind of things that you might need to know whilst living with diabetes. After the initial shock of a diabetes diagnosis wears off, family will begin adjusting to life with diabetes. With a little planning and preparation, one can resume all of normal day-to-day activities, such as exercising or going out to eat. Diabetes should not keep any person from achieving highest goals. There are Olympic athletes, professional football players, congressmen, actors and rock stars who live with diabetes. Get ready to manage diabetes with care and ease.

Living with diabetes



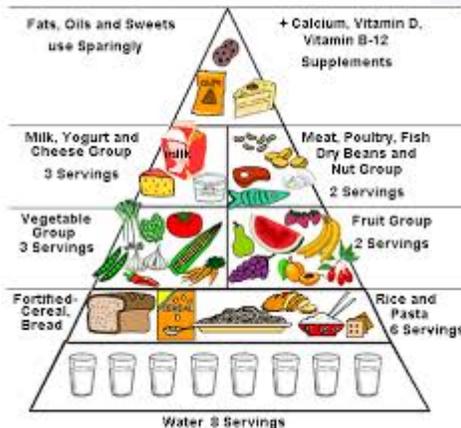
Diabetes can't stop us having a healthy, happy life!



Everyone who has diabetes should be seen at least once in every six months by a diabetes specialist (an endocrinologist or a Diabetologist) and also be seen periodically by other members of a diabetes treatment team, including a diabetes nurse educator, and a dietitian who will help to develop a meal plan for the individual. Ideally, one should also see an exercise physiologist for help in developing a physical activity plan, and perhaps, a social worker, psychologist or other mental health professional for help with the stresses and challenges of living with a chronic disease. Everyone who has diabetes should have regular eye exams (once a year) by an ophthalmologist to make sure that any

eye problems associated with diabetes are caught early and treated before they become serious. Diabetes is a disease in which the body does not produce or properly use insulin, a hormone that is needed to convert sugar, starches and other food into energy needed for daily life. The cause of diabetes is a mystery, although both genetics and environmental factors such as obesity and lack of exercise appear to play roles. There are three types of diabetes: Type 1, Type 2, Gestational Diabetes. The diet chart contains more cereals, millets, whole grains, leafy and fiber rich vegetables, small and frequent meal pattern can help to reduce the burden of diabetes mellitus.

Eat good food and lead a healthy life. Eat meals and snacks at regular times every day.



Diabetes is usually a lifelong (chronic) disease in which there are high levels of sugar in the blood. Diabetes mellitus is a metabolic disease in which the body's inability to produce any or enough insulin causes elevated levels of glucose in the blood. Diabetes is a disease in which the body is unable to properly use and store glucose (a form of sugar). Glucose backs up in the bloodstream — causing one's blood glucose (sometimes referred to as blood sugar) to rise too high. Diabetes can occur in anyone. However, people who have close relatives with the disease are somewhat more likely to develop it. Other risk factors include obesity, high cholesterol, high blood pressure, and physical inactivity. The risk of developing diabetes also increases as people grow older. People who are over 40 and overweight are more likely to develop diabetes, although the incidence of type 2 diabetes in adolescents is growing. Diabetes is more common among Native Americans, African Americans, Hispanic Americans and Asian Americans/Pacific Islanders. Also, people who develop diabetes while pregnant (a condition called gestational diabetes) are more likely to develop full-blown diabetes later in life. In type 1 (formerly called juvenile-onset or insulin-dependent) diabetes, the body completely stops producing any insulin, a hormone that enables the body to use glucose found in foods for energy. People with type 1 diabetes must take daily insulin injections to survive. This form of diabetes usually develops in children or young adults, but can occur at any age. Type 2 (formerly called adult-onset or non insulin-dependent) diabetes results when the body doesn't produce enough insulin and/or is unable to use insulin properly (insulin resistance). This form of diabetes usually occurs in people who are over 40, overweight, and have a family history of diabetes, although today it is increasingly occurring in younger people, particularly adolescents. Gestational diabetes is a temporary form of insulin resistance that usually occurs halfway through a pregnancy as a result of excessive hormone production in the body, or the pancreas' inability to make the additional insulin that is needed during some pregnancies in women without a previous history of type 1 or type 2 diabetes. Gestational diabetes usually goes away after pregnancy, but women who have had gestational diabetes are at an increased risk for later developing type 2 diabetes. Researchers have identified a small percentage of diabetes cases that result from specific genetic syndromes, surgery, chemicals, drugs, malnutrition, infections, viruses and other illnesses.

People with diabetes frequently experience certain symptoms.

- being very thirsty
- frequent urination
- weight loss
- increased hunger
- blurred vision
- irritability
- tingling or numbness in the hands or feet
- frequent skin, bladder or gum infections
- wounds that don't heal
- extreme unexplained fatigue

Treatment

There are certain things that everyone who has diabetes, whether type 1 or type 2, needs to do to be healthy. They need to have a meal (eating) plan. They need to pay attention to how much physical activity they engage in, because physical activity can help the body use insulin better so it can convert glucose into energy for cells. Everyone with type 1 diabetes, and some people with type 2 diabetes, also need to take insulin injections. Some people with type 2 diabetes take pills called "oral agents" which help their bodies produce more insulin and/or use the insulin it is producing better. Some people with type 2 diabetes can manage their disease without medication by appropriate meal planning and adequate physical activity. Also, people with diabetes need to learn how to monitor their blood glucose. Daily testing will help to determine how well their meal plan, activity plan, and medication are working to keep blood glucose levels in a normal range. Fat provides insulation for nerve cells, imparts warmth, balances hormones, keeps skin and arteries supple, lubricates joints and is part of every cell. We must eat unsaturated fats every day or else our body cannot function. People should eat Complete Proteins

(Meat, Poultry, Fish, Eggs, Cheese, Milk)& Incomplete Proteins (Vegetables, Grains, Legumes). Since proteins carry nutrients and oxygen throughout the body & fight disease by increasing antibodies and strengthening the immune system. A healthy diabetic meal plan includes: 1,500 calories - daily total carbohydrates 170 grams (45%), 40 grams (3 meals), and 15 grams (3 snacks).

II. DIABETES AND OTHER PROBLEMS

Healthcare team will encourage people with diabetes to follow meal plan and exercise program to keep blood glucose in as normal a range as possible as much of the time as possible. Because poorly managed diabetes can lead to a host of long-term complications — among these are heart attacks, strokes, blindness, kidney failure, and blood vessel disease that may require an amputation, nerve damage, and impotence in men. But happily, a nationwide study completed over a 10-year period showed that if people keep their blood glucose as close to normal as possible, they can reduce their risk of developing some of these complications by 50 percent or more.

III. RELATED STUDIES

The effects on glucose homeostasis of eleven plants used as traditional treatments for diabetes mellitus were evaluated in normal and streptozotocin diabetic mice. Dried leaves of agrimony (*Agrimonia eupatoria*), alfalfa (*Medicago sativa*), blackberry (*Rubus fruticosus*), celandine (*Chelidonium majus*), eucalyptus (*Eucalyptus globulus*), lady's mantle (*Alchemilla vulgaris*), and lily of the valley (*Convallaria majalis*); seeds of coriander (*Coriandrum sativum*); dried berries of juniper (*Juniperus communis*); bulbs of garlic (*Allium sativum*) and roots of liquorice (*Glycyrrhiza glabra*) were studied. Each plant material was supplied in the diet (6.25% by weight) and some plants were additionally supplied as decoctions or infusions (1 g/400 ml) in place of drinking water to coincide with the

traditional method of preparation. Food and fluid intake, body weight gain, plasma glucose and insulin concentrations in normal mice were not altered by 12 days of treatment with any of the plants. After administration of streptozotocin (200 mg/kg) on day 12 the development of hyperphagia, polydipsia, body weight loss, hyperglycaemia and hypoinsulinaemia were not affected by blackberry, celandine, lady's mantle or lily of the valley. Garlic and liquorice reduced the hyperphagia and polydipsia but did not significantly alter the hyperglycaemia or hypoinsulinaemia. Treatment with agrimony, alfalfa, coriander, eucalyptus and juniper reduced the level of hyperglycaemia during the development of streptozotocin diabetes. This was associated with reduced polydipsia (except coriander) and a reduced rate of body weight loss (except agrimony). Alfalfa initially countered the hypoinsulinaemic effect of streptozotocin, but the other treatments did not affect the fall in plasma insulin. The results suggest that certain traditional plant treatments for diabetes, namely agrimony, alfalfa, coriander, eucalyptus and juniper, can retard the development of streptozotocin diabetes in mice.

Twelve [plants](#) used for the traditional treatment of [diabetes mellitus](#) in northern Europe were studied using normal and [streptozotocin](#) diabetic [mice](#) to evaluate effects on [glucose homeostasis](#). The [plants](#) were administered in the diet (6.25% by weight) and/or as decoctions or infusions in place of drinking water, to coincide with the traditional method of preparation. Treatment for 28 days with preparations of burdock ([Arctium lappa](#)), [cashew](#) ([Anacardium occidentale](#)), [dandelion](#) ([Taraxacum officinale](#)), elder ([Sambucus nigra](#)), [fenugreek](#) ([Trigonella foenum-graecum](#)), guayusa ([Ilex guayusa](#)), hop ([Humulus lupulus](#)), nettle ([Urtica dioica](#)), [cultivated mushroom](#) ([Agaricus bisporus](#)), periwinkle ([Catharanthus roseus](#)), sage ([Salvia officinale](#)), and wild [carrot](#) ([Daucus carota](#)) did not affect the parameters of [glucose homeostasis](#) examined in normal [mice](#) (basal plasma [glucose](#) and [insulin](#), [glucose](#) tolerance, [insulin](#)-induced [hypoglycaemia](#) and glycated [haemoglobin](#)). After administration of [streptozotocin](#) (200 mg/kg) burdock and nettle aggravated the diabetic condition, while [cashew](#), [dandelion](#), elder, [fenugreek](#), hop, periwinkle, sage and wild [carrot](#) did not significantly affect the parameters of [glucose homeostasis](#) studied (basal [glucose](#) and [insulin](#), [insulin](#)-induced [hypoglycaemia](#), glycated [haemoglobin](#) and pancreatic [insulin](#) concentration). Guayusa and mushroom retarded the [development](#) of [hyperglycaemia](#) in [streptozotocin](#) [diabetes](#) and reduced the [hyperphagia](#), polydipsia, body weight loss, and glycated [haemoglobin](#). Mushroom also countered the initial reduction in plasma [insulin](#) and the reduction in pancreatic [insulin](#) concentration, and improved the hypoglycaemic effect of exogenous [insulin](#). These studies suggest the presence of potentially useful [antidiabetic](#) agents in guayusa and mushroom.

Can diabetes be prevented?

Maybe some day. Type 2 diabetes is the most common type of diabetes. Recent Studies show that lifestyle changes can prevent or delay the onset of type 2 diabetes in those adults who are at high risk of getting the disease. Modest weight loss (5-10% of body weight) and modest physical activity (30 minutes a day) are recommended goals. The rate of diagnosis of type 2 diabetes

in children and adolescents is increasing. Fortunately, diabetes can be managed with proper care. However, with careful attention of blood sugar control, lifestyle modifications and medications, one can manage diabetes and may avoid many of the problems associated with the disease. Proper inclusion of dietary fiber in diet can help for managing the disease easier. The reason it's so important to take charge of diabetes is that not only does diabetes contribute to chronic conditions like heart disease and high blood pressure, the complications from the very medications prescribed to control diabetes can lead to irreversible kidney damage.

IV. COMPLICATIONS OF DIABETES

- **Heart disease and stroke** Approximately 75 percent of people with diabetes will die of heart disease or stroke, and they are likely to die at a younger age than people who do not have diabetes. People with diabetes have the same cardiovascular risk as if they have already had a heart attack. People with diabetes are two to four times more likely to have heart disease (more than 77,000 deaths due to heart disease annually). Heart disease death rates are also two to four times as high as adults without diabetes. People with diabetes are two to four times more likely to suffer a stroke.
- **Blindness due to diabetic retinopathy** Each year 12,000 to 24,000 people lose their sight because of diabetes. Diabetes is the leading cause of new blindness in people 20 to 74 years of age.
- **Kidney disease due to diabetic nephropathy** Ten to 21 percent of all people with diabetes develop kidney disease. Diabetic nephropathy is the leading cause of end-stage renal disease (kidney failure), accounting for 43 percent of new cases. In 1999, 38,160 people with diabetes initiated treatment for end-stage renal disease, and 114,478 people with diabetes underwent dialysis or kidney transplantation. Kidney failure requires the patient to undergo dialysis or a kidney transplant in order to live.
- **Nerve disease and amputations** About 60 to 70 percent of people with diabetes have mild to severe forms of diabetes-related nerve damage, which can lead to lower limb amputations. In fact, diabetes is the most frequent cause of non-traumatic lower limb amputations. The risk of a leg amputation is 15 to 40 times greater for a person with diabetes. Each year, 82,000 people lose their foot or leg to diabetes.
- **Impotence due to diabetic neuropathy or blood vessel blockage** Impotence afflicts approximately 13 percent of men who have type 1 diabetes and eight percent of men who have type 2 diabetes. It has been reported that men with diabetes, over the age of 50 have impotence rates as high as 50 to 60 percent.

Reverse Diabetic Symptoms, Lose Weight, and Feel Great - It's Easier Than You Think!
Meal Plans are best to lead a happy life.

Key principles:

- The right combination of the right foods
- Eat foods high in the right kind of protein
- Let Whole gram Sundal be your snack
- Eliminate many “diabetic non friendly foods”
- Eat vegetable salad one cup a day
- Include fiber rich foods more
- Include Rice flakes, Millets & Leafy vegetables often
- Eat foods rich in anti oxidants
- Advisable to take small frequent nutritious meal
- Dine with family members
- Drink more water
- Take deep breath
- Do regular routine work
- Do regular exercise
- Laugh very often
- Lead stress free life

Drink to shrink- Six drinks that can sip on and actually lose weight.



Flavoured Water

Feeling bloated? Is there water retention near belly? [Drink more water](#). The more you drink, the better the fluid balance in your body. Besides, water offers a host of benefits for beauty and health. Try adding a bit of cucumber juice or lime to your water to ensure you drink more. This way, you get the goodness of water as well as the natural additives.

Fruit Juices- Watermelon and Pineapple

Drink some fresh and healthy fruit juices instead of sugar-filled tea or coffee for the day. Watermelon and pineapple are particularly effective—the former is a natural hydrator for the body and rich in nutrients, while the latter contains bromelain, which breaks down protein and reduces bloating. Ensure that you have these without sugar or artificial additives.

Detox Juices

Combine any fruit and vegetable and whip up a healthy drink. Not only will it deter you from mid-meal snacking, but it will also help to get healthy and glowing skin. It's ideal to mix citrus fruits with tomatoes, carrots and beetroot.

Green Tea

Beneficial green tea aids in reducing the risk of cancer and heart diseases. Green tea also helps clear body system and contains antioxidants that reduce fat—just what we need in place of our regular tea!

Dark Chocolate Shake

We know that, chocolate and diet don't go well together. But, they do. Have a sugar-free, skimmed milk dark chocolate shake in place of evening snack or morning breakfast and see the results.

Mint Iced Tea

Sugar-free mint iced tea is just right for a hot day. Have a glass to clear indigestion, [bloating](#) and get fresh. In the long run, this drink will help to cut down the cravings for calorie-filled tea and coffee breaks. Coffee has been associated with a reduced risk of developing diabetes. Caffeinated and decaffeinated coffee may have components other than caffeine that reduce blood glucose concentrations. But take the caffeine out of the coffee, and the caffeine will increase blood sugar up to 8 percent according to a recent study. This one study was conducted on 10 people with type 2 diabetes, using caffeine capsules. The dose was an equivalent of drinking 4 cups of coffee. How caffeine might raise blood sugar is unclear, perhaps a surge of adrenaline or cortisol elevates blood sugar, or caffeine alters the function of insulin. This small study opens up more questions, and hopefully more conclusive research will follow.

A study reported in Diabetes Care, March 2009, examined the effect of decaffeinated coffee on blood sugar levels in 15 overweight men (non-diabetics). The components in decaffeinated coffee, chlorogenic acid and trigonelline (also present in caffeinate coffee) reduced the glucose and insulin response for 15 minutes after ingestion of glucose in a standard OGTT, and then no longer effects. So, if you are a coffee drinker and frustrated by less than desired blood sugar control, consider switching to decaffeinated coffee. This small study was done with larger amounts of caffeine, so lesser intake of coffee may have minimal effects. More is yet to be known. Tea is a more widely used beverage than coffee, and has been used for medicinal purposes for centuries. Tea contains polyphenols - chemicals that have anti-cancer, anti-inflammatory and antioxidant effects. Tea also contains caffeine, and in a few studies, using oolong tea and green tea, have been shown to decrease blood glucose levels, improve A1C, total cholesterol and LDL cholesterol levels. Drinking green tea may lower the risk of developing type 2 diabetes. Teas have some side effects and interfere with nutrients and drug action if consumed in large or excessive quantities. Tea may interfere with the absorption of iron from food. Tea may also interfere with certain lab tests, thallium tests, uric acid tests, and vanillylmandelic acid concentrations. Tea may also worsen glaucoma due to increase eye pressure. Excessive amounts may cause insomnia, anxiety and restlessness, and increased bleeding if used with blood thinners. Again, excessive and continuous drinking of tea may have these effects, but the intake of a few cups of tea or glasses of iced tea a day are innocuous.

V. CONCLUSION

Health is Wealth. We should not live for food. To live a valuable life we should take balanced food. Prevention is better than cure. No sweat no gain. Temptation on food & laziness should be controlled. Plan evening walks, bicycle rides, and other physical activities, Timely meals, Good physical work, Stress free life, Good sleep can make us work more, earn more and help us to lead a meaningful diabetes free life.

REFERENCES

- [1] Issue: BCMJ, Vol. 48, No. 6, July, August 2006, page(s) 272-278 Articles Harvey Thommasen, MD, MSc, FCFP, William Zhang, MSc, MA
- [2] Stewart AL, Greenfield S, Hays RD, et al. Functional status and well-being of patients with chronic conditions. JAMA 1989;262:907-913. PubMed Abstract
- [3] Centers for Disease Control and Prevention. Measuring Healthy Days: Population Assessment of Health-Related Quality of Life. Atlanta, GA: CDC; 2000:44. www.cdc.gov/hrqol/pdfs/mhd.pdf (accessed 10 May 2006).
- [4] Weinberger M, Kirkman MS, Samsa GP, et al. The relationship between glycemic control and health-related quality of life in patients with non-insulin-dependent diabetes mellitus. Med Care 1994;29:1173-1181. PubMed Abstract
- [5] <http://www.diabetescare.net/nutrition-and-fitness/behavior-and-lifestyle#ixzz3F46PvStU>
- [6] <http://www.diabetescare.net/nutrition-and-fitness/behavior-and-lifestyle#ixzz3F468GC7C>
- [7] www.diabetes.org > Living With Diabetes > For Parents & Kids > Everyday Life
- [8] <http://www.diabetes.org/living-with-diabetes/parents-and-kids/everyday-life/#sthash.CCcb1CJ4.dpuf>
- [9] <http://www.diabetes.org/living-with-diabetes/parents-and-kids/everyday-life/#sthash.MiEz116E.dpuf>
- [10] Grigg A, Thommasen HV, Tildesley H, et al. Comparing self-rated health, satisfaction, and quality of life scores between diabetics and others living in the Bella Coola Valley. Social Indicators Research 2006. In press.

AUTHORS

First Author – P.Thenmozhi, M.Sc., M.A., M.Phil.,
Associate professor & Head, Department Of Homescience,
Seethalakshmi Ramaswami College, Tiruchirappalli - 620 002.

Improvement of the Enzymatic Performance of lipase from *Pseudomonas sp.* ADT3 via entrapment in alginate hydrogel beads

Arpita Dey^{*}, Tushar Kanti Maiti^{**} and Pranab Roy^{***}

^{*}Department of Biotechnology, The University of Burdwan, India

^{**}Department of Botany, The University of Burdwan, India

^{***}Department of Biotechnology, Haldia Institute of Technology, India

Abstract- Extracellular lipase producing psychrotrophic *Pseudomonas* ADT3 (NCBI GenBank Acc.no.JX914667) isolated from soil sample of Ny- Alesund, Svalbard, Arctic region produced maximal lipase activity of 527.8U/mg after 48 hours at pH 8.5 and temperature 22°C in presence of 1.2mM lead as cofactor. It was partially purified 2.9 folds by ammonium sulphate precipitation (80%). Enzymatic performance was improved by immobilization of enzyme on various carriers viz. Alginate and polyacrylamide gel. The immobilization yield of enzyme immobilized in polyacrylamide gel was low (40.0%) in comparison to that immobilized with alginate (70.0%). Different concentrations of alginate and calcium chloride were studied to acquire stable beads. Optimum concentration of alginate and calcium chloride was 2% and 0.12M respectively. The immobilized enzyme was found to be stable in alkaline pH. The maximal activity for immobilized enzyme was found at pH 8.5. Broader pH tolerance could be achieved by immobilization. Temperature optima of the enzyme showed no changes before and after immobilization i.e. 22°C. But the thermal stability was enhanced after immobilization. Immobilized enzyme remained active up to 50 °C while the activity of the free enzyme started to decrease from 40 °C. Even at 70°C immobilized enzyme retained 25% of residual activity but free enzyme totally loses enzyme activity. The storage stability of entrapped lipase up to 50% was found after 5 days at 4°C, while at 30°C the enzyme lost 60% of its activity after 2 days. The enzyme can be reused up to 5 cycles which is a promising technique for large-scale preparation of immobilized lipase for industrial applications.

Index Terms- Extracellular, psychrotrophic, arctic, immobilization

I. INTRODUCTION

In the natural environment, lipases (EC 3.1.1.3) catalyze the hydrolysis of esters formed from glycerol and long chain fatty acids [1, 2]. However, under appropriate experimental conditions, these enzymes are also very active biocatalysts for the esterification of fatty acids and transesterification reactions [3, 4]. Many lipases from microbial sources have been investigated and found to be promising catalysts for the hydrolysis and synthesis of fats and oils. Versatility of lipase leads to multiple industrial applications in food and flavour making, pharmaceuticals, synthesis of carbohydrate esters,

amines and amides, biodetergents, cosmetics and perfumery. The use of free lipases is limited by their considerably unstable nature and the resulting requirement of stringent conditions, such as particular pH and temperature [5, 6, and 7]. In order to use them more economically and efficiently in aqueous as well as in non-aqueous solvents, their activity, selectivity and operational stability can be modified by immobilization [8]. Immobilization of enzymes is the key to expand the applications of these natural catalysts by enabling easy separation and purification of products from reaction mixtures and efficient recovery of enzyme proteins. The enzyme immobilization is to entrap the enzymes in a semi-permeable supports, which prevents the enzyme from leaving while allowing substrates and products to pass through [9]. With immobilized enzymes, improved stability, reuse, continuous-operation, possibility of better control of reaction, product yields and hence more enzymatic activity over a broad range of pH and temperature can be expected [10].

Entrapment of enzyme in calcium alginate is one of the important methods of immobilization. Alginates are commercially available as water-soluble sodium alginates and they have been used for more than 65 years in the food and pharmaceutical industries as thickening, emulsifying and film forming agent. Entrapment within insoluble calcium alginate gel is recognized as a rapid, nontoxic, inexpensive and versatile method for immobilization of enzymes as well as cells [11].

The present research was based on the entrapment of extracellular cold active lipase in calcium alginate beads obtained from a newly isolated strain of psychrotrophic *Pseudomonas sp.* ADT3 from soil samples collected from Ny- Alesund (78°55'N, 11°54'E) Svalbard, Arctic region during the Indian Arctic Expedition 2009, organized by National Centre for Antarctic and Ocean Research, Goa. and also the characteristic of immobilized enzyme. The effect of independent variables such as alginate concentration, CaCl₂ concentration, and effect of pH and temperature on immobilization yield and activity of immobilized enzyme were investigated. Repeated use of the immobilized lipases was also studied with storage stability. The present communication would enhance the enzyme stability via immobilization and hence leads to multiple industrial applications in food and flavour making, pharmaceuticals, biodetergents, cosmetics and perfumery.

II. MATERIALS AND METHODS

2.1 Chemicals

All chemicals used were of analytical grade, obtained from Himedia (India) and Sigma-Aldrich Company.

2.2 Bacterial isolate

Pseudomonas ADT3 was isolated in our laboratory from soil samples collected from Ny- Alesund (78°55'N, 11°54'E) Svalbard, Arctic region during the Indian Arctic Expedition 2009, organized by National Centre for Antarctic and Ocean Research, Goa under the Ministry of Earth Science, Govt of India. The molecular identification and lipase activity studies of this isolate were done by 16S rDNA sequencing and titration assay. The ADT3 isolate could grow on olive oil as the sole carbon source [12].

2.3 Growth conditions

The ADT3 isolate could grow on minimal medium containing: 0.3% (w/v) KH_2PO_4 , 0.6% (w/v) Na_2HPO_4 , 0.05% (w/v) NaCl, 0.1% (w/v) NH_4Cl , 2 mM MgSO_4 , 0.1mM CaCl_2 with 1.0% olive oil as the sole carbon source and 2% (w/v) agar [13] at pH 8.0 by spread plate method and the culture was incubated with shaking at 22°C for 48 hrs. Pure cultures of the isolate were maintained on M9 minimal medium agar slants containing olive oil and were routinely maintained by sub culturing.

2.4 Production of lipase

ADT3 cells were grown in Erlenmeyer flasks (250 mL) with 50 mL of M9 minimal medium containing 1% olive oil as substrate and flasks were incubated in shaker incubator with 120 rpm agitation at 22°C for 48 h. Cells were harvested by centrifugation at 10,000 rpm for 10 minutes at 4°C. The supernatant obtained was filtered using 0.45 μm cellulose acetate filter membrane (Sigma-Aldrich). The cell free filtrate was used as the extracellular crude enzyme which was stored at -20°C for further studies.

2.5 Partial purification of extracellular lipase by Ammonium Sulphate Fractionation

The online program ammonium sulphate calculator from EnCor Biotechnology, Inc, Gainesville, Florida [14] was used for calculating the amount of solid ammonium sulphate to be added for getting desired fractions. Precipitation was done at 0-10%, 10-20% and 20-30% saturation for 2-3 hours and at 40-50%, 50-60%, 60-80%, and 80-90% saturation of ammonium sulphate for overnight incubation, with magnetic stirrer at 4°C. After each precipitation step, the fraction was centrifuged at 12,000 rpm for 15 minutes at 4°C. All the precipitates obtained were resuspended in a minimal amount of buffer (10 mM Tris-HCl, pH 8.0) and dialyzed against large volume of the same buffer by successive change in buffer after 2 hours at 4°C. The process was continued till the last trace of ammonium sulphate was removed. The obtained precipitates (partial purified enzyme) were dissolved in Tris-HCl buffer (50 mM, pH 7.5) and used for entrapment.

2.6 Lipase assay

Extracellular lipase activity in bacterial culture supernatants after centrifugation (12,000 g for 20 min) was determined by titrimetric assay using olive oil as substrate. Lipase activity was examined by titrating free fatty acids liberated from triglycerides with alkali [15, 16]. The reaction mixture contained 1ml of 0.1 M Tris- HCl buffer pH 8.0, 50mM KCL, 200 μl Tween 20, 1 ml

olive oil, 1ml of culture supernatant at 22°C for 3 hrs. The reaction mixture was mixed well on a reciprocal shaker at 60 rpm. After incubation, the mixture was shaken vigorously with 3 mL of ethanol to stop the enzyme reaction and break down the emulsion. The amount of fatty acids liberated during the reaction was estimated by titrating with 10 mM NaOH using phenolphthalein indicator. Blank contained the same components except enzyme solution.

One unit of lipase activity was defined as the amount of enzyme required to liberate 1 μMole equivalent of free fatty acid per minute. Specific activity was defined as units of lipase activity per milligram protein. The results obtained were means of triplicates for each experiment.

$$\text{Specific activity} = \frac{\text{ml titrant} \times \text{molarity of titrant} \times 1000}{\text{Amount of protein (mg)}}$$

2.7 Immobilization of partially purified lipase

2.7.1 Calcium alginate beads

The partially purified enzyme solution was mixed with sodium alginate solution (2%) in 1:1 ratio. The lipase-alginate mixture was added dropwise into calcium chloride (0.12 M) solution with continuous stirring with magnetic stirrer at 4°C. As soon as the drop of lipase-alginate solution mixed with CaCl_2 solution, Na ions of Na-alginate were replaced by the Ca^{+2} ions of CaCl_2 solution, which finally formed Ca-alginate beads. The lipase immobilized in beads of calcium alginate was stirred in the calcium chloride solution for another hour at 20°C [17]. The beads thus formed were washed 3-4 times with deionized water to remove any traces of chloride and finally suspended in 50 ml solution of 0.05 mM Tris of pH 7.5. These beads were dried and weighed for further studies.

2.7.2 Polyacrylamide gel entrapment method

Potassium phosphate buffer (pH 7.0, 0.2 M) was used to dissolve acrylamide 2.85 g, bisacrylamide 0.15 g, ammonium persulphate 10 mg and 0.1 mL TEMED. Equal ratio of chilled partially purified lipase solution and chilled potassium phosphate buffer were mixed well and poured into sterile flat bottom 4 inch diameter Petri plates. After polymerization the acrylamide gel was cut into equal size cubes. The acrylamide cubes were placed in sodium phosphate buffer (pH 7.0, 0.2 M) for 1 h in the refrigerator. These cubes were washed thoroughly two to three times with sterile water [18].

2.8. Protein Assay

The amount of protein content before and after immobilization was determined by the method of Bradford using BSA as the standard [19].

III. RESULT AND DISCUSSION

3.1 Characterization and Identification of psychrotrophic lipase producing bacteria

The strain was identified as *Pseudomonas sp.ADT3* based on biochemical tests satisfying the Bergey's manual of Determinative Bacteriology and 16S rDNA Gene Amplification and Sequencing. The NCBI GenBank Accession number of the isolate was JX914667. SEM micrograph reveals that the cells

were rod shaped of length 4.5 µm and diameter 0.9 µm. The results of experiments on Antibiotic sensitivity assay showed that ADT3 strain is resistant to Oxycillin and ampicillin [12]. The organism is capable of growth on lipid as the sole carbon source which was confirmed by Rhodamine B plate assay where orange fluorescence under UV illumination indicates the presence of lipolytic activity.

3.2 Partial purification of *Pseudomonas sp. ADT3* lipase

The purification procedure of the cold-active lipase produced by *Pseudomonas* ADT3 was summarized in Table 1. The lipase was partially purified about 2.9 fold over the crude extract with 64.4% recovery using 60-80% ammonium sulphate for precipitation. The specific enzyme activity of the partially purified lipase increased to 1433.8 U/mg proteins **Table 1**.

Table 1 Purification process of lipase from the psychrotrophic bacterium

Purification steps	Total enzyme (U/L)	Total protein (mg)	Specific activity (U/mg)	Purification Fold	Enzyme Yield (%)
Crude extract	4,45,000	900	494.4	1.0	100
Ammonium sulphate precipitation (60-80%) saturation	2,86,760	200	1433.8	2.9	64.4

3.3 Production of extracellular lipase from *Pseudomonas sp. ADT3*

Pseudomonas produced an extracellular lipase during growth on a medium containing olive oil as the sole carbon source. The results recorded in Figure 1 indicated that the production of lipase increased steadily with the cultivation time and the best enzyme production, about 88.0 U/mg was reached after 48 days of cultivation. Maximum lipase production was observed during the stationary phase of growth and then the activity declined. In our study, the secretion of lipase was

induced by 1% olive oil, as no other organic nutrient or carbon substrate other than olive oil was supplemented in the growth medium for the production of lipase. However, the enzyme production decreased on increasing the incubation period showing lipase activity of 64.11 U/mg after 3 days of incubation. This may be attributed to the fact that lipase production has been frequently inhibited by the end products namely, glycerol and fatty acids [20, 21] **Figure 1**

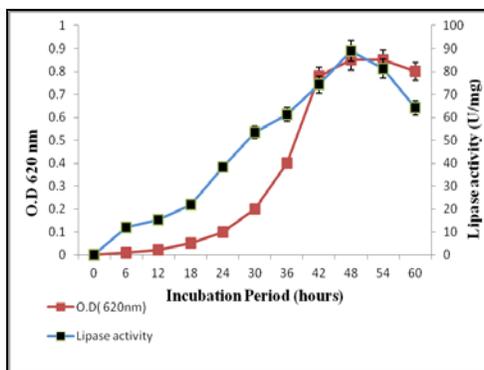


Fig 1: Effect of different incubation period on lipase activity and growth by *Pseudomonas* ADT3 Lipase production was observed during the stationary phase of growth. Maximum enzyme production (88.0 U/mg) was observed after 48 hours of cultivation and then the activity declined. The bar denotes standard deviation (SD). When the error bar cannot be seen, the deviation is <5%.

3.4 Immobilization of *Pseudomonas ADT3* lipase using different carriers

The experimental results of immobilized *Pseudomonas ADT3* lipase using different entrapment techniques are shown in **Table 2**

Table 2: Immobilization of *Pseudomonas ADT3* lipase using

Carriers	Enzyme added (U/mg) P	Bound Enzyme (U/mg) R	Immobilization yield (%)
Ca-alginate	350	245	70.0
Polyacrylamide	350	140	40.0

$$\text{Immobilization yield (\%)} = \frac{R}{P} \times 100$$

The immobilization yield of lipase entrapped in calcium alginate (70.0%) was higher than that of enzyme entrapped in polyacrylamide (40.0%). The low yield with polyacrylamide blocks may be due to the diffusional resistance of nutrients and

oxygen into the matrices. These results are in accordance with studies on *A. niger* [22, 18] and *Candida rugosa* [23]. Therefore, alginate was considered to be the best matrix for the production of lipase and the partially purified enzyme entrapped by sodium alginate was used for further investigation **Figure 2**.

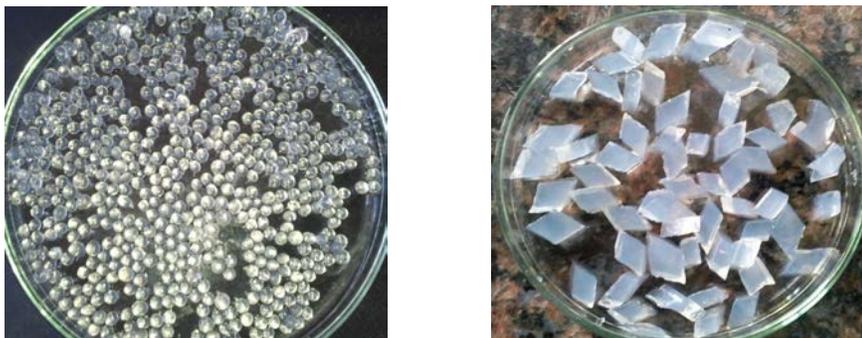


Fig 2 a. Calcium alginate beads containing immobilised lipase of *Pseudomonas ADT3*. b. Polyacrylamide cubes containing immobilised lipase of *Pseudomonas ADT3*

3.5 Effect of Sodium Alginate Concentration:

Due to the cross-linking between alginate and Ca^{2+} leads to gelation, alginate concentration is a major parameter for enzyme gel entrapment. Therefore effect of alginate concentration on immobilization yield was investigated. For the determination of suitable concentration of sodium alginate different percentage of sodium alginate (1%-5%) were used to acquire beads with greater stability maintaining the CaCl_2 concentration (0.12 M). The percent entrapped activity was found maximal at 2% (w/v) sodium alginate concentration. The percentage immobilization

yield was 55.7%. Maximum leakage of enzyme from beads occurred at 1% (w/v) sodium alginate concentration owing to the larger pore sizes of the less tightly cross linked fragile Ca-alginate beads. Immobilization yield decreased on increasing alginate concentration. At 4% and 5% (w/v) sodium alginate concentration the entrapped activity of the enzyme was found very low which might be due to the high viscosity of enzyme entrapped beads, which decreased the pores size and thus hindered the substrate transfer from the bulk phase into the alginate beads [24] **Figure 3**

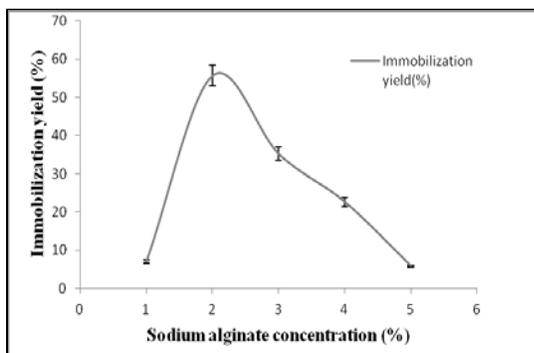


Fig 3: Effect of sodium alginate concentration on percent immobilization of lipase from *Pseudomonas ADT3* The Percentage immobilization yield peak shows maxima at 2% sodium alginate concentration. Immobilization yield decreases on increasing alginate concentration. The bar denotes standard deviation (SD). When the error bar cannot be seen, the deviation is <5%.

3.6 Effect of calcium chloride

Concentration of calcium chloride (0.05-0.3 M) was also varied keeping alginate concentration constant (2%) in order to acquire stable beads capable of securing maximum enzyme and it was found that CaCl_2 (0.12 M) retained highest activity of

entrapped enzyme and as calcium chloride concentration increased beyond 0.12 M the activity decreased. It was also reported a decrease in the relative enzyme activity of alkaline protease when they increased the concentration

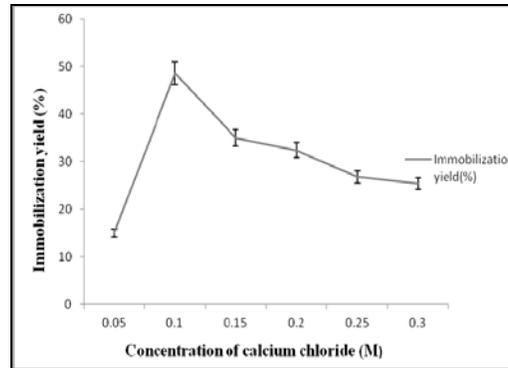


Fig 4: Effect of calcium chloride concentration on percent immobilization of lipase from *Pseudomonas ADT3* The Percentage immobilization yield peak shows maxima at 1.2mM calcium chloride concentration. Immobilization yield decreases on increasing calcium chloride salt concentration. The bar denotes standard deviation (SD). When the error bar cannot be seen, the deviation is <5%.

of CaCl_2 used to form capsule [25]. They observed that the pH of the CaCl_2 solution changes with its concentration which might be a factor to affects the activity of entrapped enzyme **Figure 4**

3.7 Effect of pH on activity of the free and immobilized *Pseudomonas ADT3* lipase

Effect of pH on the specific enzyme activity of both free and immobilized lipase of *Pseudomonas ADT3* was studied by varying the pH of the reaction medium from 2.0–9.0 with 1.2 mM

Pb as cofactor at 22°C and the pH profile is shown in **Figure 5**. The lipase was found to be nearly alkaline which showed higher specific enzyme activities for both free and immobilized enzyme at pH 8.5. In free lipase first, there is a sharp increase in enzyme activity at pH 3.5 which drops around neutral pH followed by a peak at pH 8.5 that gradually falls into a plateau. The two peaks for free enzyme were due to presence of two isoforms of the enzyme. The maximum activity of enzyme was found around pH 8.5 (alkaline) for free and immobilized lipase.

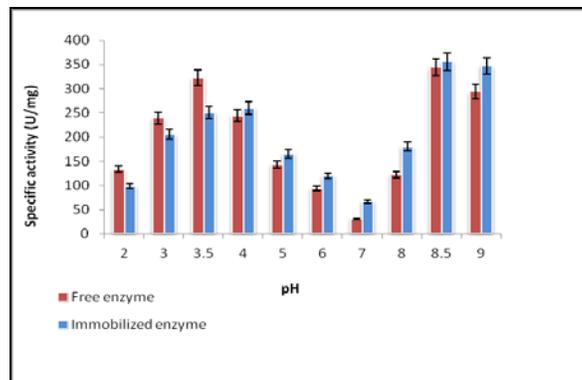


Fig 5 Effect of pH on the specific enzyme activity of free and immobilized lipase with 1.2 mM Pb at 22°C. Optimum activity could be detected for both free and immobilized lipase at pH 8.5. Error bars with 5% SEM are displayed.

It was reported that the surface of the beads in which the enzyme is localized has a cationic or anionic nature. This charged surface of beads and entrapped enzyme produces a charged microenvironment, which ultimately affects the nature of the active enzyme protein and alters the pH of the entrapped enzyme [26]. So, in the present case the surface of beads at acidic

pH might produce some effect on the active lipase, thus the activity of enzyme is lowered than free enzyme. The surface of beads at neutral pH had produced no effect on the active lipase, thus the activity of free and immobilized enzyme remained almost the same. Residual activity was measured and found that immobilized enzyme was stable over a broad range of pH. This

indicated that immobilization appreciably improved the stability of lipase in alkaline region. Similar results were obtained on using immobilized *Candida rugosa* lipase on chitosan [27]

3.8 Effect of temperature on activity and stability of the free and immobilized *Pseudomonas ADT3* lipase

The temperature dependence of the hydrolytic activity of free and immobilized lipase is shown in **Figure 6**. The optimum

reaction temperature (22°C) of the lipase was not altered by immobilization at pH 8.5. The immobilized lipase showed higher specific enzyme activities above 22 °C as compared to the free lipase. However enzyme activity starts decreasing at 40 °C for immobilized lipase and at 30 °C for the free enzyme. These results indicate that lipase is more stable when immobilized in a matrix with higher hydrophobicity [28].

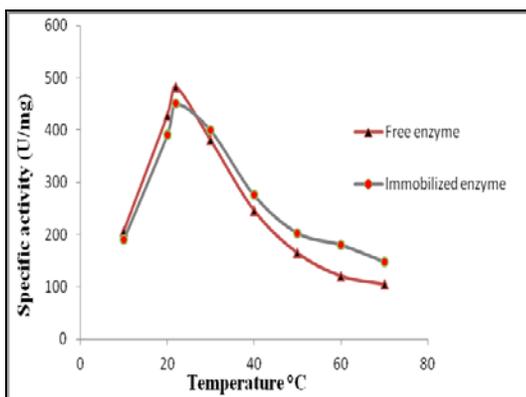


Fig 6 Effect of reaction temperature on lipase activity of immobilized and free lipase from *Pseudomonas ADT3*. The lipase activity peaks shows maxima at 22°C for both free and immobilized lipase. With increase in temperature the activity decreases.

Heat stability of the lipase entrapped in alginate matrices is much better than that of the corresponding free enzyme **Figure 7**. Immobilized enzyme remained active up to 50 °C while the activity of the free enzyme started to decrease from 40 °C. At 60

°C the residual activity of the immobilized lipase was 46% compared to 10% for free enzyme. Even at 70°C immobilized enzyme retained 25% of residual activity but free enzyme totally loses enzyme activity.

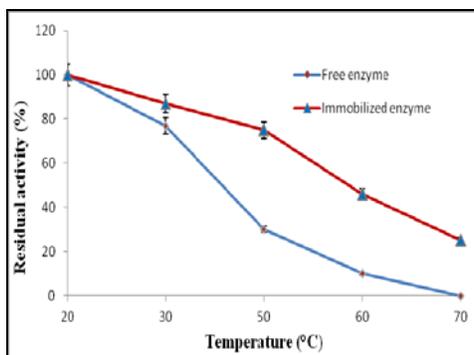


Fig 7 Thermal stability of free and immobilized lipase. Residual activity of the lipase was measured at different temperature at pH 8.5. The activity of the free enzyme started to decrease from 40 °C but immobilized enzyme remained active up to 50 °. At 60 °C the residual activity of the free enzyme was only 10% compared to 46% for immobilized enzyme. Free enzyme totally loses enzyme activity at 70°C but immobilized enzyme retained 25% of residual activity. The bar denotes standard deviation (SD). When the error bar cannot be seen, the deviation is <5%.

3.9 Reusability of Immobilized lipases

One of the important characteristics of an immobilized enzyme is its stability and reusability over an extended period of time. The residual activity of the immobilized enzyme for the

repeated use is shown in **Figure 8**. The enzyme showed 83% activity during the second reuse, 75% activity on its third use and 62% activity of entrapped enzyme were

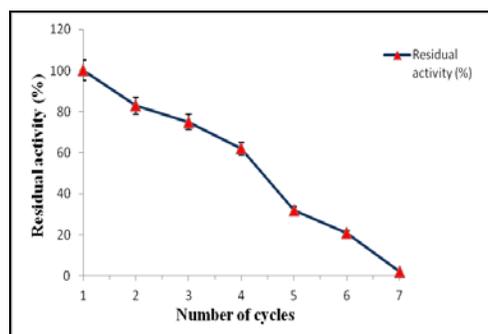


Fig 8 Effect of repeated use of immobilized *Pseudomonas* ADT3 lipase on residual activity at pH 8.5 and 22°C The immobilized enzyme can be reused up to 5 cycles with residual activity of 32%. The enzyme showed 83% activity during the second reuse, 75% activity on its third use and 62% activity of entrapped enzyme were observed during the fourth cycle. The bar denotes standard deviation (SD). When the error bar cannot be seen, the deviation is <5%.

observed during the fourth cycle. This decrease in activity was due to the leakage of enzyme from the beads, occurred due to the washing of beads at the end of each cycle [17, 27].

3.10 Storage stability of enzyme

Immobilized enzyme was stored at two temperatures, viz. 4°C and 30°C. The activity was noted up to 10 days **Figure 9**. It was found that beads which were stored at 4°C showed 30% loss of activity after 48 hours, 50% activity loss after 5 days and 95% loss of activity after 10 days. On the contrary beads which are stored at 30°C showed 60% loss of activity after 48 hours, 95%

loss of activity after 4 days and complete loss of activity after 5 days. These results clearly revealed the fact that the enzyme remained considerably stable at refrigeration temperature of 4°C. It was reported 36% loss in the activity of immobilized dextranase at 30°C after 3 hours and 86% loss in activity at 40°C within two hours [29], also reported 96% loss of activity of dextranase at 40°C within two hours [30]. It was also reported the stability of alkaline proteases up to nine days after entrapment of cells of *Bacillus subtilis* PE-11 [31].

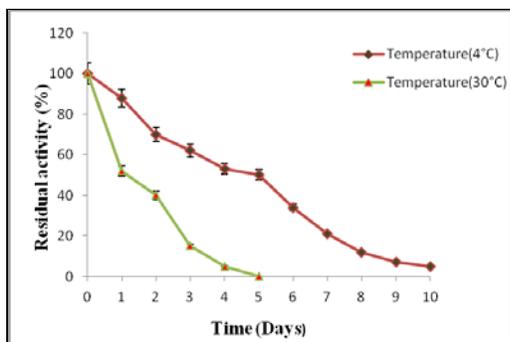


Fig 9 Effect of temperature on storage stability of immobilized lipase from *Pseudomonas* ADT3 At 4°C 70% of residual activity was found after 2 days and 50 % activity after 5 days. On contrary beads stored at 30°C showed 40% of residual activity after 2 days and 5% activity after 4 days and complete loss of activity after 5 days. The bar denotes standard deviation (SD). When the error bar cannot be seen, the deviation is <5%.

IV. CONCLUSION

The main objective of the present study was to increase the efficiency of the newly isolated strain of *Pseudomonas sp* ADT3 from Arctic region via immobilization to produce lipase. The enzyme was partially purified approx.2.9-fold with an overall yield of 64.4 % and specific activity of 1433.8 U/mg with 80% ammonium sulphate precipitation. The immobilization yield of lipase entrapped in calcium alginate was found 70.0%. In order to acquire stable beads capable of securing maximum enzyme 2% sodium alginate and 0.12 M CaCl₂ was found optimum

retaining highest activity of entrapped enzyme. The immobilized enzyme was found to be stable in alkaline pH. The maximal activity for immobilized enzyme was found at pH 8.5. The temperature optima for both free and immobilized remained same i.e. 22°C. But the immobilized enzyme remained active up to 50 °C while the activity of the free enzyme started to decrease from 40 °C. Even at 70°C immobilized enzyme retained 25% of residual activity but free enzyme totally loses enzyme activity. The enzyme can be reused up to 5 cycles which is a promising technique for large-scale preparation of immobilized lipase for industrial applications. Enhancement of stability of lipase from a

psychrotrophic *Pseudomonas* via immobilization leads to multiple industrial applications in food and flavour making, pharmaceuticals, biodetergents, cosmetics and perfumery. Further work needs to elucidate the immobilization of enzymes in combination with protein engineering techniques to improve enzymes of industrial significance.

ACKNOWLEDGEMENT

The authors thank the Department of Science and Technology (DST), New Delhi, Govt of India, for the grant supporting this research work. Prof P. Roy acknowledges National Centre for Antarctic & Ocean Research, Goa for facilitating the expedition to Ny-Alesund, Norway where the samples were collected.

CONFLICT OF INTERESTS

There is no conflict of interests between the authors or with any other person regarding any of the works reported or software used in this paper.

REFERENCES

[1] Sharma R., Chisti Y. and Banerjee U. C. (2001) Production, purification, characterization and applications of lipases. *Biotechnology Advance* 19: 627-662.

[2] Rodrigues D. S., Mendes A., Adriano W. S., and Gonçalves L. R. B. (2008) Multipoint covalent immobilization of microbial lipase on chitosan and agarose activated by different methods. *Journal of Molecular Catalysis B: Enzymatic* 51: 100-109.

[3] Balcão V. M., Paiva A. L. and Malcato F. X. (1996) Bioreactors with immobilized lipases. *Enzyme Microbial Technology* 18: 392-416.

[4] Pandey A., Benjamin S., Soccol C. R., Nigam P., Krieger N. and Soccol V. T. (1999) The realm of microbial lipases in biotechnology. *Biotechnology and Applied Biochemistry* 29: 119-131.

[5] Tang Y. J., Li Y. (2007) *China Bio.* 27: 110.

[6] Guzmán F., Barberis S., Illanes A. (2007) *Electron. J. Biotechnology* 10: 279.

[7] Ken D., Johnstone M., Dieckelmann, Michael P., Jennings J. T., Blanchfield I. T. (2006) *Understanding Biology Using Peptides American Peptide Symposia* 9: 511.

[8] Hung T. C., Giridhar R., Chiou S. H. and Wu W. T. (2003). Binary immobilization of *Candida rugosa* lipase on chitosan. *Journal of Molecular Catalysis B: Enzymatic* 26: 69-78.

[9] Gemeiner P. (1992) *Enzyme Engineering: Immobilized Biosystems*. Chichester UK, Ellis Horwood, Ltd.

[10] Ruckenstein E. and Wang X. (1993). Lipase immobilized on hydrophobic porous polymer supports prepared by concentrated emulsion polymerization and their activity in the hydrolysis of triacylglycerides. *Biotechnology and Bioengineering* 42: 821-828.

[11] Fraser J.E. and Bickerstaff G.F. (1997). Entrapment of enzymes and cells in calcium alginate. In *Immobilisation of Enzymes and Cells*, Humana Press, pp: 61-66.

[12] Dey A., Chattopadhyay Amarnath, Mukhopadhyay Subhra Kanti, Saha Pradipta, Chatterjee Sabyasachi, Maiti Tushar Kanti and Roy Pranab (2014) An Approach to the Identification and Characterisation of a Psychrotrophic Lipase Producing *Pseudomonas* sp ADT3 from Arctic Region. *Advances in Bioscience and Biotechnology* 5: 322-332

[13] Choo D.W., Kurihara T., Suzuki T., et al. (1998) A Cold-Adapted Lipase of an Alaskan Psychrotroph. *Pseudomonas* sp. Strain B11-1: Gene Cloning and Enzyme Purification and Characterization. *Applied and Environmental Microbiology*, 64: 486-491. <http://dx.doi.org/10.1007/s11947-008-0104-8>

[14] Coligan J. E., Dunn B. M., Speicher D.W., Wingfield P. T., and Ploegh H. L., Eds. (1998) *Current Protocols in Protein Science*, JohnWiley & Sons, Chichester, UK.

[15] Amada K, Haruki M, Imanaka T, Morikawa M, Kanaya S (2000) Overproduction in *Escherichia coli*, purification and characterization of a family I.3 lipase from *Pseudomonas* sp. MIS38. *Biochem Biophys Acta* 1478: 201-210.

[16] Watnabe N, Ota Y, Minoda Y, Yamada K (1977) Isolation and identification of alkaline lipase producing micrororganisms, cultural conditions and some properties of crude enzymes. *Agric. Biol. Chem.* 41: 1353-135.

[17] Won K., Kim S., Kim K. J., Park H. W. and Moon S. J. (2005). Optimization of lipase entrapment in Ca-alginate gel beads. *Process Biochemistry*. 40: 2149-2154.

[18] Ellaiah P., Prabhakar T., Ramakrishna B., Thaer Taleb A. and Adinarayana K. (2004). Production of lipase by immobilized cells of *Aspergillus niger*. *Process Biochemistry* 39: 525-528.

[19] Bradford MM (1976) A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. *Anal Biochem* 72: 248-254.

[20] Rio Del, Serra J. L., Valero D., Poch F. M. and Sola C. (1990). Reaction scheme of lipase production by *Candida rugosa* growing on olive oil. *Biotechnology Letters* 12: 335-338.

[21] Kanwar L. and Goswami P. (2002). Isolation of *Pseudomonas* lipase produced in pure hydrocarbon substrate and its application in the synthesis of isoamyl acetate using membrane immobilized lipase. *Enzyme and Microbial Technology* 31: 727-735.

[22] Jamil N. I. and Omar I. C. (1992). Lipase production using *Aspergillus niger*. *Journal of Biosciences* 3: 31-41.

[23] Ferrer P. and Carles S. (1992). Lipase production by immobilized *Candida rugosa* cells. *Applied Microbiology and Biotechnology* 37:737-741.

[24] Knezevic Z., Bobic S., Milutinovic A., Obradovic, B., Mojovic L., Bugarski B. (2002). Alginate immobilized lipase by electrostatic extrusion for the purpose of palm oil hydrolysis in lecithin/isooctane system. *Process Biochemistry* 38: 313-318.

[25] Roig M.G., Rashid D.H. and Kenndy J.F. (1995). High-alkaline protease from *Bacillus* PB92 entrapped in calcium alginate gel: Physicochemical and microscopic studies. *Appl. Biochem. Biotechnol.* 55: 95-121.

[26] Norouzi D. (2003) Review, Enzyme immobilization, the state of art in *Biotechnology, Iranian J. Biotechnol.* 1: 197-206.

[27] Hung T. C., Giridhar R., Chiou S. H. and Wu W. T. (2003). Binary immobilization of *Candida rugosa* lipase on chitosan. *Journal of Molecular Catalysis B: Enzymatic* 26, 69-78.

[28] Shaw J. F., Chang R. C., Wang F. F. and Wang Y. J. (1990). Lipolytic activities of a lipase immobilized on six selected supporting materials. *Biotechnology and Bioengineering* 35: 132-137.

[29] Qader S.A.U.L., Aman A., Syed N., Bano S. and Azhar A. (2007). Characterization of dextranucrase immobilized on calcium alginate beads from *Leuconostoc mesenteroides* PCSIR-4. *Ita. J. Biochem.*, 56: 158-162.

[30] Chellapandian M., Larios C., Sanchez-Gonzalez M., and Lopez-Munguia A. (1998). Production and properties of a dextranucrase from *Leuconostoc mesenteroides* IBT-PQ isolated from 'pulque', a traditional Aztec alcoholic beverage. *J. Ind. Microbiol. Biotechnol.* 21: 51-56.

[31] Adinarayana K., Bapi Raju K.V.V.S.N. and Ellaiah P. (2004). Investigations on alkaline protease production with *B. subtilis* PE-11 immobilized in calcium alginate gel beads. *Process Biochem.* 39: 1331-1339.

AUTHORS

First Author – Arpita Dey, Msc. in Biotechnology, Department of Biotechnology (Recognized by DBT-Govt. Of India), The University of Burdwan, West Bengal-713104, India., e-mail address: arpitadey086@gmail.com

Second Author – Dr. Tuhar Kanti Maiti, Doctorate in Botany, Department of Botany, The University of Burdwan, West Bengal-713104, India., e-mail address: tkmbu@yahoo.co.in

Third Author – Prof. Pranab Roy, Post Doctorate, Department of Biotechnology, Haldia Institute of Technology, West Bengal, India., e-mail address: pranabroy@rediffmail.com

Correspondence Author – Arpita Dey, Msc. in Biotechnology, Department of Biotechnology (Recognized by DBT-Govt. Of India), The University of Burdwan, West Bengal-713104, India., e-mail address: arpitadey086@gmail.com, Mobile number: 09474787058, 09775270675, Fax number: 091342-2657231

Negative Pressure Wound Therapy versus Conventional Wound Therapy in Large Wounds

Sandhya Nagaraj*, Ramesh Hosmani**, Ravi Shankar J C***

*Assitant Professor, Dept. of General Surgery, Karnataka Institute of Medical Sciences, Hubli, Karnataka, India

**Associate Professor, Dept. of General Surgery, Karnataka Institute of Medical Sciences, Hubli, Karnataka, India

***Resident, Dept. of General Surgery, Karnataka Institute of Medical Sciences, Hubli, Karnataka, India

Abstract- Aim: To assess the feasibility and efficacy of Topical Negative Pressure (TNP) dressing using a locally constructed TNP device and comparing it with regular gauze dressings for large wounds.

Materials and Methods: 28 patients were recruited from the in patient ward, Dept of Surgery, KIMS, Hubli, Karnataka, India during the period of June 2014 to November 2014. Of the 28 patients 14 patients received TNP dressings, 14 patients were treated with regular saline dressings.

Results: The use of vacuum therapy in large wounds resulted in improved wound healing as evidenced by improved WBS, faster healing, shorter hospital stay and improved graft uptake compared to conventional dressing.

Conclusion: Topical Negative Pressure (TNP) dressing is a safe and economical method for treatment of large wounds.

Index Terms- Topical negative pressure dressing(TNP), Wound Healing, Vacuum assisted closure(VAC), Wound Bed Score(WBS)

I. INTRODUCTION

Acute and chronic wounds and are a major cause of morbidity and impaired quality of life. They affect at least 1% of the population and represent a significant risk factor for hospitalization, amputation, sepsis, and even death. The treatment of large wounds remains a significant challenge to practitioners, a cause of pain and discomfort to the patients, and costly (1,2,3).

Negative pressure wound dressing is a new technology that has been shown to accelerate granulation tissue growth and promote faster healing, thereby decreasing the period between debridement and definite surgical closure in large wounds. Vacuum-assisted wound closure (VAC) is a wound management technique that exposes wound bed to negative pressure and provides a moist wound-healing environment. This technique has been developed and popularized world-wide by Prof. Louis

Argenta(4) and Prof. Micheal Morykwas(5) from the USA and by Dr Win Flieschmann from Germany(6)

Wound and their management are fundamental to the practice of surgery. Dressings are applications for wounds to provide the ideal environment for wound healing. Many studies have been conducted comparing various dressing modalities for different types of wounds(7,8,9,10,11,12). In developing countries like India where the cost of dressing is a major concern, the locally constructed negative pressure dressings was an option.

II. AIM OF THE STUDY

To assess the feasibility and efficacy of Topical Negative Pressure (TNP) dressing using a locally constructed TNP device and comparing it with regular gauze dressings for large wounds.

III. MATERIALS AND METHODS

28 patients were recruited from the inpatient ward, Dept of Surgery, KIMS, Hubli, Karnataka, India. Of the 28 patients 14 patients received TNP dressings(Group 1), 14 patients were treated with regular saline dressings(Group 2). Wound etiologies included cellulitis/fasciitis, diabetic foot ulcers and others. In all cases underlying wound etiologies and co-morbidities were addressed and treated. All patients underwent debridement before involving into each group.

Inclusion criteria: Post-debridement wounds, Diabetic foot ulcers, Chronic ulcers, Pressure sores

Exclusion criteria: Fistulas to organs or body cavities, Gangrenous tissue with eschar, Osteomyelitis, Malignancy in the wound

Treatment of control group-Patients were treated with regular saline guaze dressings daily.



Figure 1: Conventional saline dressings

Treatment of experiment group

- **Materials needed**-locally available foam, ryles tube, adhesive plaster/Opsite, tubings, wall suction and guage.
- **Procedure**-Foam was autoclaved and was cut according to the shape of the wound. Ryles tube placed in between 2 layers of foam. Adhesive plaster applied around the

foam air-tight. Now the ryles tube is connected to the wall suction using tubings. Negative pressure is set to 125mmHg. Negative pressure is applied for 48hrs continuously, patient was taught to detach the tubing when ambulating. Dressing is opened after 48hrs.



Figure 2: Topical negative pressure dressing application

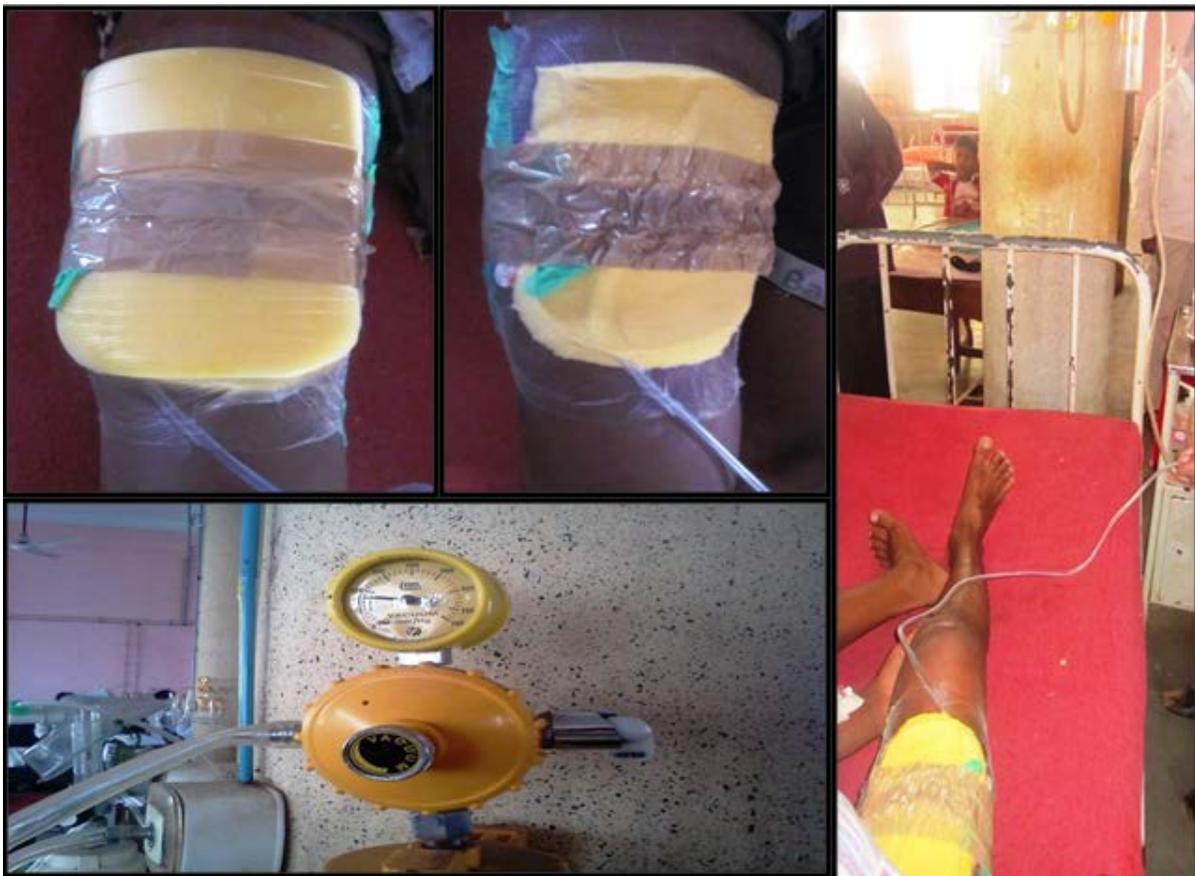


Figure 3: Topical negative pressure dressing after application

- **Assessment-** wound bed score, time taken for 90% granulation tissue, percentage of graft take, duration of hospital stay
- **Wound Bed Score(13)-** The scores are divided into 4 quartiles:4-9, 10 to 11, 12 and 13 to 16 ,with an increase in wound bed score from one unit to next unit there is a 22.8% increase in odds of healing. This

wound bed score will be useful in assessment as a predictor of initial healing and possibly for monitoring adequate response to treatment , with the expectation of achieving quartile increases in the wound bed time

Wound Bed Score (WBS)

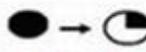
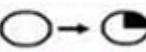
	Scores of 0	Scores of 1	Scores of 2
Black Eschar	 0	 1	 2
Eczema/Dermatitis	 0	 1	 2
Depth	 0	 1	 2
Scarring (fibrosis/callus)	 0	 1	 2
Color of wound bed	 0	 1	 2
Oedema/Swelling	 0	 1	 2
Resurfacing epithelium	 0	 1	 2
Exudate Amount	 0	 1	 2
Add scores for each column →			
TOTAL SCORE (Max=16)			



Figure 4: WBS 8-Before TNP dressing



Figure 5: WBS 15- After TNP dressing

IV. OBSERVATION AND RESULTS

Table 1: Demographic Data

	TNP Dressing	Conventional Dressing
NO. OF PATIENTS	14	14
AGE IN RANGE	29-75	23:75
GENDER RATIO (M:F)	13:1	12:2

Table 2: Etiology

	TNP Dressing	Conventional Dressing
DIABETIC FOOT ULCER	2	1
POST-CELLULITIS	11	12
TRAUMA	1	0
OTHERS	0	1

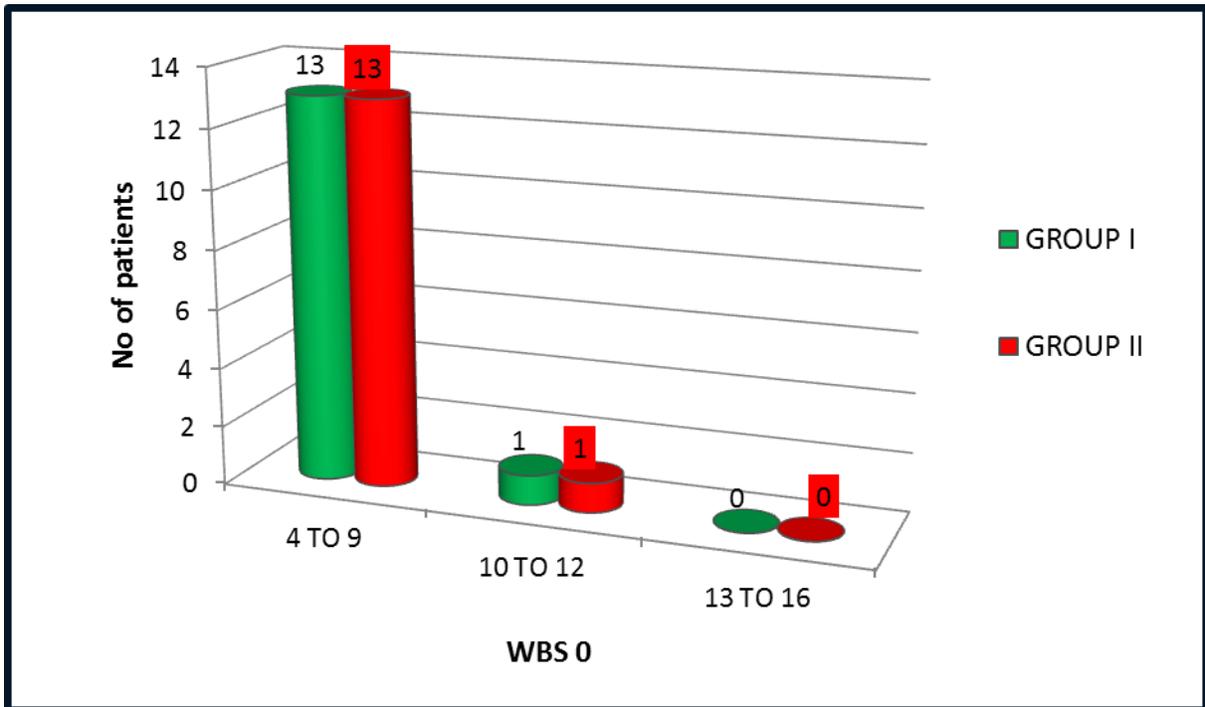


Figure 6: WBS on day 0

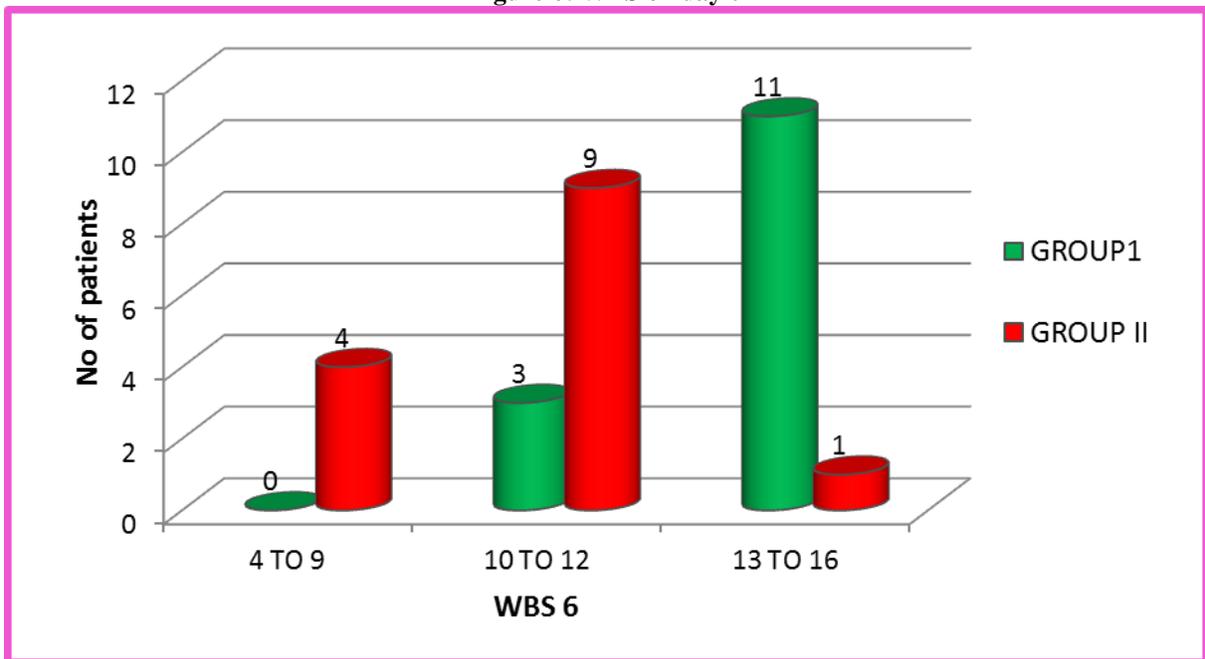


Figure 7: WBS on day 6

Table 3: Time taken for 90% granulation tissue

AVG TIME TAKEN FOR GRANULATION TISSUE	DAYS
TNP Dressing	13.71
Conventional Dressing	24.35

Table 4: Hospital Stay

	DAYS
TNP Dressing	28.21
Conventional Dressing	37.28

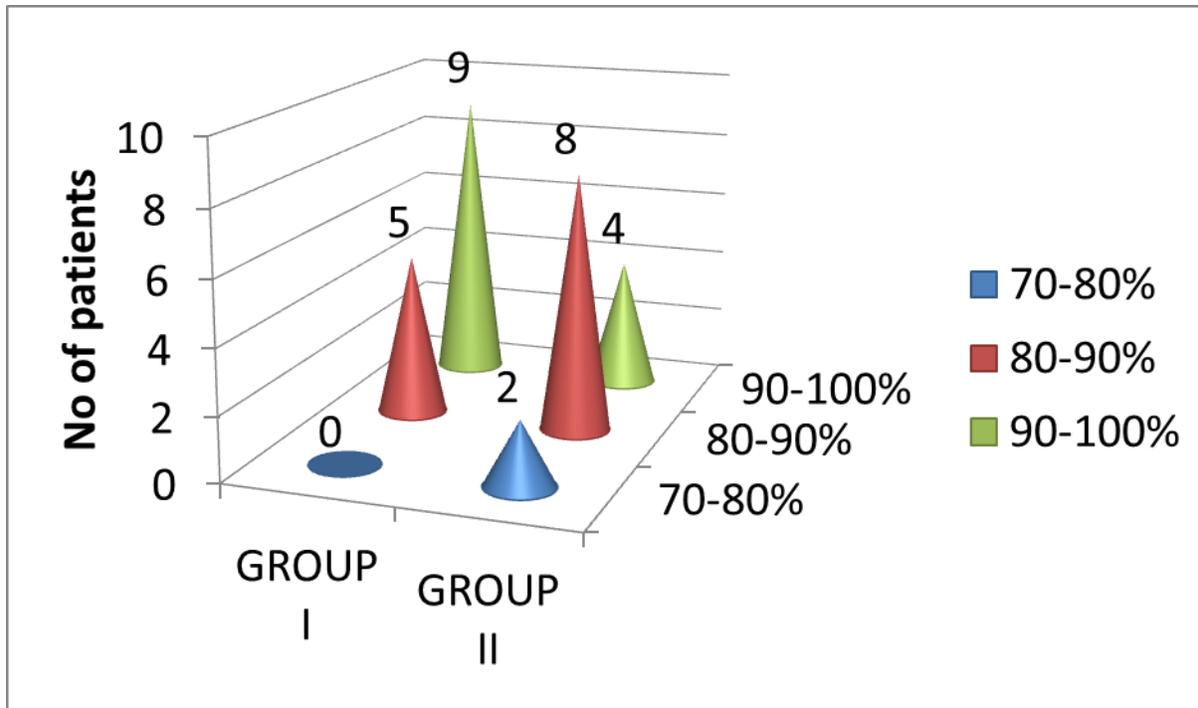


Figure 8: Percentage of graft take

V. DISCUSSION

In this study we demonstrated that the use of vacuum therapy in large wounds results in improved wound healing compared to conventional moist gauze therapy. This is reflected by on average healthier wound conditions i.e. improved WBS, faster healing, increased graft uptake. In our study we demonstrated improved wound healing in acute wounds following initial debridement. One of the important advantages of vacuum therapy is the fact that healthier wound conditions were achieved without intermediate debridements. In most of the conventionally treated patients, debridement was necessary to remove slough.

Mechanism of action that has attributed to TNP therapy are increase in blood flow, promotion of angiogenesis, reduction of wound surface area in certain types of wounds, modulation of the inhibitory contents in wound fluid, induction of cell proliferation(14).

Another major advantage of vacuum therapy is the reduction of the number of dressing changes to once every 48 h instead of daily dressings as in conventional therapy. The reduction of dressing changes leads to an improved patient compliance as the patient suffers less often pain and inconvenience. In our study we have used a locally constructed VAC device which is very economical to the patient owing more cost-effective than conventional dressing.

VI. CONCLUSION

We have found that even with locally constructed TNP device healthier wound conditions were observed compared with conventional therapy, with a faster wound healing. Together, with the fact that locally constructed topical negative pressure device uses inexpensive materials and are easily available and can be used in inpatients in most hospitals.



Figure 9: Large wound over leg: Before and after TNP dressing

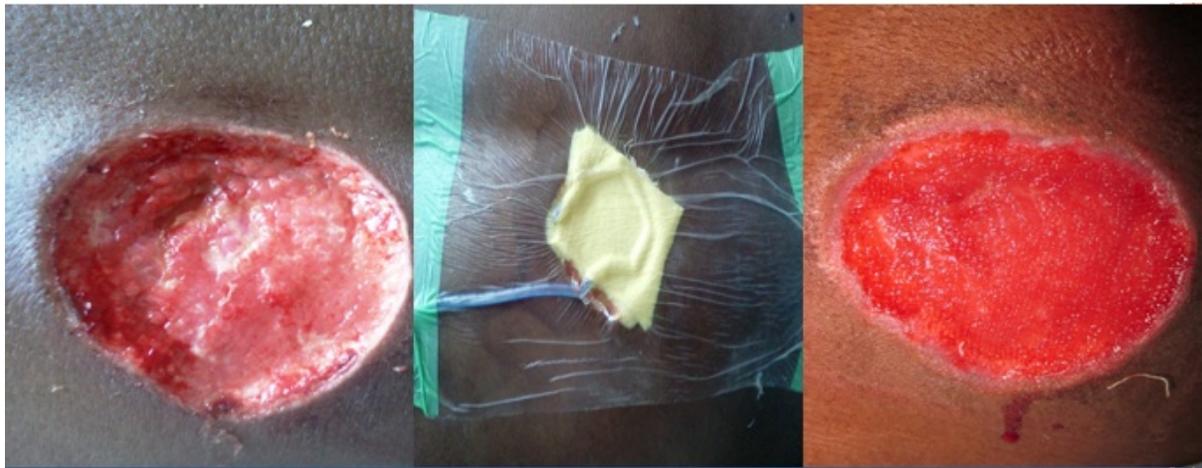


Figure 10: Wound over back: Before and after TNP dressing



Figure 11: Large wounds over foot: Before and after TNP dressing



Figure 12: Large wounds over leg and foot: Before and after TNP dressing

REFERENCES

- [1] Gregor S, Maegele M, Sauerland S, et al. Negative pressure wound therapy. A vacuum of evidence Arch Surg 2008;143:189-196.
- [2] Group Health Care-Clinical Review Criteria. Negative Pressure Wound Therapy(NPWT) Pumps
- [3] Sia SF and Fong EP. Modified vacuum assisted closure. JUMMEC 2006; 9(2): 24-27
- [4] Argenta LC, Morykwas MJ. Vacuum-assisted closure: a new method for wound control and treatment: clinical experience. Ann Plast Surg 1997;38:563-76.
- [5] Morykwas MJ, Argenta LC, Shelton-Brown EI, McGuirt W. Vacuum-assisted closure: a new method for wound control and treatment: animal studies and basic foundation. Ann Plast Surg 1997;38:553-62.
- [6] Trung D. Bui et al. Negative pressure wound therapy with off-the-shelf components. The American Journal of Surgery 192 (2006) 235–237.
- [7] C. M. Moues et al. Comparing conventional gauze therapy to vacuum-assisted closure wound therapy: A prospective randomised trial. Journal of Plastic, Reconstructive & Aesthetic Surgery 2007; 60(6): 672-81.
- [8] C. M. Moues et al. A review of topical negative pressure therapy in wound healing: sufficient evidence. The American Journal of Surgery 2011; 201:544-556.
- [9] Cengiz Tavusbay et al. the use of vacuum assisted closure system for management of difficult wounds. Biomedical Research 2013; 24(3): 329-336.
- [10] Ghulam Rasool et al. vacuum assisted wound closure and normal saline dressing in treatment of Gustilo type 2, type 3a, type 3b open fracture of tibia. Rawal medical Journal. Vol. 38. No. 4. October-December 2013.
- [11] Kushagra Sinha et al. Vacuum assisted closure therapy versus standard wound closure therapy for musculoskeletal injuries. Hindawi publishing company. Advances in orthopedics. Volume 2013. Article ID 245940.
- [12] Ketan Gupta et al. Comparison of vacuum assisted closure therapy with standard wound therapy for open musculoskeletal injuries. International journal of recent trends in science and technology, volume 9, issue 2, 2013. Pp 168-170
- [13] Vincent Falanga et al. Wound bed score and its correlation with healing of chronic wounds. Dermatologic Therapy, volume 19, issue 6, pages 383-390, November 2006
- [14] Dennis P. Orgill et al. The mechanism of action of vacuum assisted closure- More to learn, Surgery 2009; 146: 40-51.

AUTHORS

First Author- Sandhya Nagaraj, MBBS, MS, Assistant Professor, Department of General Surgery, Karnataka Institute of Medical Sciences, Hubli-580022, Karnataka, India, [email-sandhyanagaraj21@gmail.com](mailto:sandhyanagaraj21@gmail.com)

Second Author- Ramesh Hosmani, MBBS, MS, Associate Professor, Department of General Surgery, Karnataka Institute of Medical Sciences, Hubli-580022, Karnataka, India, email-drrameshosmani@gmail.com

Third Author- Ravi Shankar J C, MBBS, Resident in General Surgery, Department Of General Surgery, Karnataka Institute of Medical Sciences, Hubli-580022, Karnataka, India, [email-drravishankarjc89@gmail.com](mailto:dravishankarjc89@gmail.com)

Prevalence of Cardiac Manifestations in HIV Infected Patients Correlating with CD4 Count

Dr. P. Shravan Kumar, M.D*, Dr. R. Siddeswari, M.D**, Dr. D. Sridhar, M.D***, Dr. P. Shakuntala, M.D***, Dr. Sitaram, M.D***, Dr. S. Manohar, M.D****

* Assoc. Prof. of Medicine ; Osmania General Hospital, Hyderabad, Telangana State, India.

** Prof. of Medicine; Osmania General Hospital, Hyderabad, Telangana State, India.

*** Asst Prof. of Medicine; Osmania General Hospital, Hyderabad, Telangana State, India.

**** Professor & HOD of Medicine; Osmania General Hospital, Hyderabad, Telangana State, India.

Abstract- HIV affects all the systems of the body which may be due to HIV infection itself or due to opportunistic infections or malignancies. The clinical and pathologic findings in various organ systems including the pulmonary, integumentary, gastrointestinal, hematologic and neurologic systems have been well described. Reports of cardiac abnormalities in HIV and AIDS patients, however, have been less well documented. : The cardiovascular diseases in HIV/AIDS are increasing in the developing world. The Present study is to evaluate Cardiac abnormalities in HIV infected adult patients with noninvasive investigations like electrocardiography , echocardiography and correlating with cd4 count .

The cardiac disorders that were identified in our study were diastolic dysfunction (33%), pericardial effusion (12%), systolic dysfunction (9%), pulmonary hypertension (8%), dilated cardiomyopathy (5.5%), mitral regurgitation (3.5%), clot (1%) and vegetation (0.5%).

Index Terms- HIV, echocardiography NACO, (National AIDS control organization), cardiomyopathy. pericardial effusion.

I. INTRODUCTION

According to Global Summary of the AIDS Epidemic / 2013 Number of People living with HIV in 2013, Total 35.0 million; Adults are 31.8 million ; women are 16.0 million ; Children (< 15 years) are 3.2 million. People newly infected with HIV in 2013, Total 2.1 Million in whom Adults are 1.9 million ; Children (< 15 years) are 2,40,000. No of deaths due to AIDS in 2013 are Total 1.5 million ; Adults are 1.3 million and Children (< 15 years) 1,90,000¹.

Infection with human immunodeficiency virus (HIV) is a leading cause of acquired heart disease worldwide and specifically of accelerated atherosclerosis, symptomatic heart failure, and pulmonary arterial hypertension (PAH)^{2,3,4,5} Cardiac complications of HIV infection tend to occur late in the disease in those with acquired immunodeficiency syndrome (AIDS) or prolonged viral infection and are therefore becoming more prevalent as longevity improves².

Clinical criteria Cardiac disease was identified clinically as per the standard clinical examination.

Radiological criteria

Standard radiological criteria were used to diagnose the lung disorders and cardiomegaly. The diagnosis of cardiomegaly was considered when the cardiac-to-thoracic width ratio was above 50 percent⁶.

ECG criteria

Standard electrocardiographic criteria were used to detect abnormalities in ECG⁷

Echo Cardiographic criteria

2D echocardiography is an ideal imaging modality for assessing left ventricular (LV) size and function. A qualitative assessment of the ventricular cavity and systolic function can be made directly from the 2D image by experienced observers. 2D echocardiography is useful in the diagnosis of LV hypertrophy and is the imaging modality of choice for the diagnosis of hypertrophic cardiomyopathy. Other chamber sizes are assessed by visual analysis, including the left atrium and right-sided chambers. 2D echocardiography is the imaging modality of choice for the detection of pericardial effusion, which is easily visualized as a black echolucent ovoid structure surrounding the heart.⁸

Echocardiographic Definition dilated Cardiomyopathy

Diagnostic criteria (or major criteria; both must be present)

1. LV ejection fraction <45% and/or fractional shortening <25%, diagnosed by echocardiogram, isotopes or ventriculography
2. Left ventricular end-diastolic diameter>117% of the predicted value corrected for age and body surface area, which corresponds to 2 standard deviations from the expected normal limit + 5% (applying Henry's formula)⁹

Echocardiographic Definition of systolic dysfunction

The most common denominator of LV function continues to be the ejection fraction (EF) which is the stroke volume divided by end diastolic volume. The most common method for determining EF is Modified Simpsons method. The value above 50% is considered normal but according to recommendations of American Society of Echocardiography (ASE), a value above 55% is normal, 45% to 54% is mildly abnormal, 30% to 44% moderately abnormal and below 30% severely abnormal.

Echocardiographic definition of diastolic dysfunction

Advanced diastolic dysfunction can lead to isolated diastolic heart failure, now referred to as heart failure with normal ejection fraction (HFNEF).

Diagnosis of HFNEF is based on following criteria:

1) Presence of clinical syndrome of heart failure, 2) Presence of normal ejection fraction (>50%), 3) Presence of diastolic dysfunction, 4) E/E' (ratio of mitral Doppler E wave velocity to tissue Doppler 5) early diastolic velocity, i.e. E' greater than 15:1 indicative of increased LV filling pressure, and 6) Usually non-dilated heart. Echocardiography can confidently assess diastolic functions by evaluating mitral inflow Doppler, tissue Doppler, pulmonary vein, LA volume index etc¹⁰

Echo cardiographic diagnosis of pulmonary hyper tension

Common echo cardiographic features of PAH include right atrial enlargement, right ventricular enlargement and dysfunction, small under filled left-sided heart chambers, interventricular septal flattening, tricuspid regurgitation with elevated velocity, and reduced tricuspid annular plane systolic excursion (TAPSE)¹¹

All patients were evaluated for their CD4 counts and for the presence of opportunistic infections.

II. MATERIALS AND METHODS

The study was done prospectively from November 2011 to October 2013 at Osmania General Hospital, Hyderabad a tertiary care referral centre. Two hundred patients who were seropositive for HIV infection were selected for this study. Sero positivity was determined by the established NACO guidelines. The ethics clearance was obtained from the appropriate authority appointed by the institution (ethics committee).

Inclusion Criteria

1. All patients, above 18 years who are HIV seropositive by NACO criteria and willing for cardiac evaluation. Both symptomatic and asymptomatic patients were included in the study.
2. Patients below 18 years, with congenital or pre-existing heart disease diagnosed before the diagnosis of HIV infection, HIV positive patients with diabetes or hypertension. Patients on ART were excluded from the study.

Methods

A detailed history, general physical examination and systemic examination was done for each patient with special emphasis on cardiovascular system. Routine investigations done on HIV infected patients were obtained for all the patients. All patients were subjected to non-invasive cardiovascular investigation like chest x-ray, ECG and ECHO. Angiograms were not done due to the cost considerations.

The following features were used to diagnose cardiac conditions.

Clinical criteria, Radiological criteria, ECG criteria, Echocardiographic Criteria

III. RESULTS AND OBSERVATIONS

Mean CD₄ count in the study population less than 200 in 129 patients (64.5%), CD₄ count between 201-350 in 51 patients (25.5%) and CD₄ count more than 350 in 20 patients (10%).

In the study group 134 patients had AIDS (129 patients with CD₄ count <200 and 5 five patients with CD₄ count more than 200 but with AIDS-defining opportunistic illnesses) and 66 patients did not have AIDS.

Components of Cardiac manifestations

Cardiac disorder	Clinically detected	Detected by Investigation	Detected by both	Total Number (n=200)	%
Systolic dysfunction	6	18	6	18	9.0
Diastolic dysfunction	0	66	0	66	33
Mitral Regurgitation	4	7	4	7	3.5
Pericardial effusion	1	24	1	24	12.0
Dilated cardiomyopathy	6	11	6	11	5.5
Hypertrophic Cardiomyopathy	0	1	0	1	0.5
Pulmonary hypertension	0	16	0	16	8.0
Clot	0	2	0	2	1.0
Vegetation	0	1	0	1	0.5

ECG AND X- RAY findings

ECG Findings	Number	Percentage
Normal	160	80

Sinus Tachycardia	32	16
Low Voltage Complexes	1	0.5
Features of IHD	6	3.0
Features of LVH	1	0.5
X Ray Findings Cardiomegaly	13	6.5

ECG findings

80 percent of our patients had normal ECG. Commonest abnormalities were Sinus Tachycardia (16 %), Low voltage complexes (0.5%), IHD changes (3%), LVH (0.5%).

Of the clinical and biochemical parameters low hemoglobin level is significantly associated with the presence of the cardiac disorders.

Symptomatic cardiac disease was present in patients with AIDS (CD₄ count less than 200).

Most common opportunistic infection tuberculosis found in n=41, cryptococcol meningitis in n=6, candidial infections in n=4 CMV retinitis in n=2, chronic diarrhea in n=3 pneumocystic jirovecii pneumonia in n=2 and Herpes Zoster in 2 patients.

Correlation of CD4 counts with Pericardial effusion and Cardiomyopathy

CD4 Counts	Total number of patients	Pericardial effusion	Pulmonary HTN	Cardiomyopathy
1 – 200	129 (64.5%)	21 (16.3%)	9 (56.25%)	10 (7.8%)
201 – 350	51 (25.5%)	2 (3.9%)	6 (37.5%)	2 (3.9%)
> 350	20 (10%)	1 (5%)	1 (6.25%)	0 (0%)
Total	200	24	16	12

IV. DISCUSSION

Prevalence of cardiac involvement in HIV disease varies from 5% to 50% but symptomatic involvement occurs in 5% to 7% of patients only. Most common clinically significant cardiac abnormality due to direct HIV infection is HIV-associated dilated cardiomyopathy. There is evidence of myocarditis and HIV has been isolated from myocardial cells. Diagnosis can be supported by chest radiograph and electrocardiogram and confirmed by echocardiography and elevated serum NTproBNP. CD4+ count in these patients is generally >200/cumm. HIV associated cardiomyopathy has poor prognosis. Other findings on echocardiography may be diastolic dysfunction, pericardial effusion, right ventricular hypertrophy, pulmonary arterial hypertension and non-bacterial thrombotic endocarditis¹².

In HIV-infected patients, concurrent pulmonary infections, pulmonary hypertension, anemia, portal hypertension, malnutrition, or malignancy can alter or confuse the characteristic signs that define heart failure in other populations. Thus patients with LV systolic dysfunction can be asymptomatic or have New York Heart Association Class III or IV heart failure^{2 13}.

Echocardiography is useful for assessing LV systolic function in these patients and, in addition to diagnosing LV dysfunction, often reveals either low to normal wall thickness or LV hypertrophy and dilation, as well as left atrial dilation¹⁴. Dilated cardiomyopathy can be related to the direct action of HIV on myocardial tissue or to proteolytic enzymes or cytokine mediators induced by HIV alone or in conjunction with co-infecting viruses¹⁵. Diastolic dysfunction is common in long-term survivors of HIV infection. Such dysfunction may precede systolic dysfunction and signal an early manifestation of HIV-associated cardiac disease.¹⁶

Pulmonary Hypertension is rare in the general population, occurs in approximately 0.5% of HIV-infected patients. Its

prevalence has not changed with the introduction of HAART. Before the HAART era, pericardial effusions occurred in up to 11% of patients with AIDS. The prevalence reaches a mean of approximately 22% in asymptomatic patients after 25 months. Cardiac abnormalities associated with HIV infection include premature myocardial infarction (MI) or stroke, pericardial effusion, lymphocytic interstitial myocarditis, dilated cardiomyopathy (frequently with myocarditis), left ventricular (LV) diastolic dysfunction, infective endocarditis, and malignancy (myocardial Kaposi sarcoma and B-cell immunoblastic lymphoma)²

V. CONCLUSIONS

In our study Male to Female ratio 1.7:1. Most patients are in the younger age group. Only 1% of the patients were above 60 years. Prevalence of cardiac involvement was 48%. Only 5.5% patients were symptomatic. Mean CD₄ count is significantly lower in patients with cardiac disorder than in patients without cardiac disorder. Lower CD₄ count was significantly associated with the presence of pericardial effusion. 20% of patients had ECG abnormalities Commonest being sinus tachycardia 16%, IHD 3%, LVH and low voltage complex 0.5%. Of the noninvasive investigations 24.5% had chest x-ray abnormalities commonest being pulmonary tuberculosis 9%, cardiomegaly 6.5%, pneumonia 5% and pleural effusion 3% The cardiac disorders that were identified by 2D Echo in our study were diastolic dysfunction (33%), pericardial effusion (12%), systolic dysfunction (9%), pulmonary hypertension (8%), dilated cardiomyopathy (5.5%), mitral regurgitation (3.5%), clot (1%) and vegetation (0.5%). Cardiac disorders in HIV patients are common, only small percentage are symptomatic and non invasive investigation like Echo cardiography is helpful in early diagnosis of asymptomatic cardiac disorders.

REFERENCES

- [1] WHO – HIV Departmental; July 21, 2014 ; World Organization, UNAIDS, UNICEF.
- [2] Stacy D. Fisher and Steven E. Lipshultz ; Cardiovascular Abnormalities in HIV-Infected Individuals Chapter 70; Braunwald's Heart Disease; 9th Edition; A Text book of Cardiovascular Medicine; Vol. 2, MANN ZIPES LIBBY BONOW Pg No. 1624-1635.
- [3] Currie PF, Jacob AJ, Foreman AR, et al: Heart muscle disease related to HIV infection: Prognostic implications. *BMJ* 309:1605, 1994.
- [4] Lipshultz SE, Orav EJ, Sanders SP, Colan SD: Immunoglobulins and left ventricular structure and function in pediatric HIV infection. *Circulation* 92:2220, 1995
- [5] Lipshultz SE (ed): *Cardiology in AIDS*. New York, Chapman & Hall, 19986 Complications of Vertically Transmitted HIV Infection (P2C2 HIV) Study Group. *Circulation*
- [6] Adam: Grainger & Allison's Diagnostic Radiology, 5th ed.2008.
- [7] Goldberger: *Clinical Electrocardiography: A Simplified Approach*, 7th ed.2006. 117. Sahn DJ, DeMaria A, Kisslo J. Echocardiography: results of a survey of echocardiographic measurements. *Circulation* 1978; 58:1072-83.
- [8] Rick A. Nishimura ; Panithaya Chareonthaitawee Chapter 229 ; Noninvasive Cardiac Imaging: Echocardiography, Nuclear Cardiology, and MRI/CT Imaging, Harrison's principles of internal medicine vol2 18th edition, published by Mc Graw Hill Medical. Pg. No. 1840-1852
- [9] Satish Kumar Parashar***** Based on Mestroni et al. Guidelines for the study of familial dilated cardiomyopathies. *Eur Heart J* 1999, 20:93-102 ; 1012.5
- [10] Satish kumar parashar Echocardiography chapter 5 API Text Book of Medicine Vol. 19th Edition; Editor YP Munjal ; Pg No. 585-594.
- [11] Vallerie V. McLaughlin and Marc Humbert Pulmonary Hypertension chapter 74, Braunwald's Heart Disease; 9th Edition ; A Text book of Cardiovascular Medicine; Vol. 2, MANN ZIPES LIBBY BONOW pg no1682-1702.
- [12] Anil Kumar Tripathi, Shailendra P Verma; – (Non-Opportunistic Infections 16.6 API Text Book of Medicine 9th Edition; Editor YP Munjal ; pg No. 1029 vol 1.
- [13] Lipshultz SE, Mas CM, Henkel JM, et al: HAART to heart: Highly active antiretroviral therapy and the risk of cardiovascular disease in HIV-infected or exposed children and adults. *Expert Rev Anti Infect Ther* 10:661, 2012.
- [14] Lang S, Mary-Krause M, Cotte L, et al: Impact of individual antiretroviral drugs on the risk of myocardial infarction in human immunodeficiency virus-infected patients: A case-control study nested within the French Hospital Database on HIV ANRS cohort CO4. *Arch Intern Med* 170:1228, 2010.
- [15] Pozzan G, Pagliari C, Tuon FF, et al: Diffuse-regressive alterations and apoptosis of myocytes: Possible causes of myocardial dysfunction in HIV-related cardiomyopathy. *Int J Cardiol* 132:90, 2009.
- [16] Reinsch N, Neuhaus K, Esser S, et al: German competence network for heart failure; German competence network for HIV AIDS. Prevalence of cardiac diastolic dysfunction in HIVinfected patients: results of the HIV-HEART study. *HIV Clin Trials* 11:156, 2010.

AUTHORS

First Author – Dr. P. Shravan Kumar, M.D., Assoc. Prof. of Medicine; Osmania General Hospital, Hyderabad, Telangana State, India.

Second Author – Dr. R. Siddeswari, M.D., Prof. of Medicine; Osmania General Hospital, Hyderabad, Telangana State, India.

Third Author – Dr. D. Sridhar, M.D., Asst Prof. of Medicine; Osmania General Hospital, Hyderabad, Telangana State, India.

Fourth Author – Dr. P. Shakuntala, M.D., Asst. Prof. of Medicine; Osmania General Hospital, Hyderabad, Telangana State, India.

Fifth Author – Dr. Sitaram, M.D., ; Osmania General Hospital, Hyderabad, Telangana State, India.

Sixth Author – Dr. S. Manohar, M.D., Professor & HOD of Medicine; Osmania General Hospital, Hyderabad, Telangana State, India.

Effect of Pure and Modified Gum Arabic on the Mechanical Properties of Poly (Vinyl Chloride)

Sani I. Alhassan¹, Paul A. P. Mamza² and Aliyu M. Ja'o³

¹Department of Chemistry Kano University of Science and Technology, Wudil, Kano Nigeria.

²Department of Chemistry Ahmadu Bello University Zaria, Kaduna Nigeria.

³Department of Chemistry Federal University Kashere, Gombe State.

Abstract- Physical modification of pure gum arabic was carried out by plasticization of gum arabic with ethylene glycol. The chemical method was performed by acid hydrolysis, acetolysis and acetate formation. Both the pure and modified gums were mixed with PVC at different compositions and cast into films using tetrahydrofuran as solvent. Water absorption study revealed that the acetolysis sample (ACT) absorbs water the most at 14% water absorption, followed by ethylene glycol formulation (EGL) at 3.9%. However, pure gum (PGM) has the lowest water absorption at 2.1%. From the mechanical test, it shows that the acetic anhydride sample (AAN) has the highest modulus with 180.14N/mm² at 10, 140.1N/mm² at 20%, and 147.67N/mm² at 30% gum composition. For pure gum (PGM), the modulus drops from 139.66 to 97.18N/mm² at 10 to 30% gum composition then finally increases. The ACT formulation shows decrease in modulus as the percent of filler increases. Modulus of ethylene glycol (EGL) drops at 20, 40 and 70% filler composition. It was found that the tensile strength of the chemical modification formulations reinforced the PVC matrix at 10%/90%, 20%/80% and 30%/70% gum/PVC compositions for AAN and at 10%/90% and 20%/80% gum/PVC compositions for ACT. Though EGL showed increase at 30%/70% composition, its tensile strength is similar to that of the unmodified gum (PGM), decreasing with increasing gum concentration.

Index Terms- elastic modulus, percent elongation, gum arabic, poly (vinyl chloride), tensile strength

I. INTRODUCTION

Polysaccharides have been described as high molecular weight polymers formed by condensation of many monosaccharide units or their derivatives. They have also been defined as polymeric substances, the building blocks of which are monosaccharide. From the foregoing, polysaccharides could be said to be long chain carbohydrate molecules built from some monosaccharides such as glucose, rhamnose, galactose, etc. or their derivatives. Polysaccharides could be classified based on their chemical compositions. In this regard a polysaccharide which yields only one type of monosaccharide on hydrolysis is called homoglycan e.g starch, while those which yield two or more types of monosaccharides are called heteroglycan e.g. gum Arabic.

PVC can be made softer and more flexible by the addition of plasticizers, the most widely used being phthalates. In

this form, it is used in clothing and upholstery, electrical cable insulation, inflatable products and many other applications in which it would originally have replaced rubber (Titow, 1984). As an amorphous polymer, PVC resin is extensively formulated to produce an extremely large variety of compounds (Blanco, 2000). Also due to its inexpensive nature and flexibility it is used in plastic pressure pipes systems for pipelines in the water industries. The capability of PVC to perform such diverse functions is due to its ability to incorporate various additives to suit the numerous applications (Titow, 1984).

Fillers are particulate material, such as minerals, diatomaceous earths, and talc, which are added to polymers to reduce cost. Fibrous reinforcements, such as glass and carbon fibers, are added to polymer to increase stiffness and to some degree strength. Both types of materials tend to increase the viscosity of the polymer, especially at low shear rates, resulting in the formation of yield stress. At high shear rates, the effect is less pronounced as the viscosity approaches that of the neat resin. In addition to increase in pressure drops associated with processing these composite materials, they tend to lead to wear of the screws, eventually reducing the performance of the extruder (Mascia, 1974). Fillers have been used in plastics industrially worldwide for many decades. The primary purpose for using in thermoplastic matrix is its ability to modify properties (e.g to improve strength and stiffness, scuff resistance, enhance thermal conductivity and electrical properties, dimensional stability etc. (Charles et al, 2005).

Effect of additives mainly plasticizers and fillers, on the mechanical properties of PVC were studied and the experimental results have shown that tensile strength decreased with increasing plasticizer content for the group of samples free of filler (Elgozali and Hassan, 2008). The trend was completely reversed in the group where the sample contained filler. They also confirmed that the elongation at break is inversely proportional to plasticizer content for the group free of filler, while it is directly proportional to plasticizer content for that containing filler. In another study by Liu and Zhang (2007), the effects of acetanilide, adipic acid and potassium hydrogen phthalate as nucleating agents on PVC crystallization were investigated by differential scanning calorimetry (DSC), wide angle x-ray diffraction (WAXD) and fourier transform infrared spectroscopy (FTIR). The experimental results indicated that all the three additives were compatible with PVC to some extent, but adipic acid compatibility with PVC was less satisfactory. They confirmed that the three additives improved PVC crystallinity and acetanilide decreased PVC glass transition temperature (T_g) and narrowed PVC melting range, while adipic acid and

potassium hydrogen phthalate raised the T_g of PVC and widen its melting range. All additives did not affect PVC crystal system and all samples were in orthorhombic system. Moreover, acetanilide and adipic acid shrank PVC spacing and improved the crystal perfection of PVC, but potassium hydrogen phthalate swelled spacing and reduced the perfection of PVC crystal.

Labib and Williams, (1984) studied the surface properties of polyvinyl chloride containing organotin stabilizers and calcium stearate, and the surface properties of the additives themselves. They used Zeta-potential measurements to determine the charge on the surface of additive-containing polyvinyl chloride and related this to chemical reactions of the additive materials. They discovered the major chemical reactions were those involving hydrolysis of tin-ester linkages in the organotin compounds and dissociation of carboxylic acid groups. They also discovered that as a result of these reactions, the surface charge of the polymer depends strongly on the pH of the aqueous medium in contact with the surface.

The mechanical properties of both unplasticized and plasticized PVC expose to 25% concentrated HCl/NH₃ solutions were another set of studies investigated by Mamza and Solomon, (2008). In their study, the stress/strain relationship before and after exposure of the samples compressed molded film, to acidic and basic media for 72 hours was investigated. The tensile testing suggested that depolymerization of PVC is enhanced in basic medium due to neutralization of liberated HCl, hence resulting to decrease in its mechanical properties, while the mechanical properties of those exposed to acidic medium are appreciably reinforced due to minimal depolymerization. According to Harris (1969), the tensile properties of polymers, apart from defining the quality of production as well as their design and engineering behavior also indirectly measure other properties of the material for which correlation exist. For example, a plastic film of high tensile strength and elongation, in all directions, will likely have high impact strength. Tensile properties may also be used to monitor chemical or physical changes taking place in a polymer. The study of the effects of Ca/Zn stearate and organotin heat stabilizers and Zeolite, CaCO₃, Cellulose and Luffa flours filler, and their concentrations (2.5, 2, 10 and 20% by weight) on production of flexible PVC foams by chemical blending agent, azodicarbonamide was done by Demir et al., (2008). They determined foam morphology density, compressive mechanical properties and water uptake capacities of the samples. Morphology of the sample without any filler showed that employment of Ca stearate and Zn stearate stabilizers instead of organotin stabilizer increased foam formation and decreased pore sizes and regularity in pore size distribution. Foams having organotin stabilizer were more resistant to heat than the ones with Ca/Zn stearate for long heating period. Foams, including organotin-based heat stabilizer, have compact structure. It was observed that, samples containing Zeolite, CaCO₃, Cellulose or Luffa flour had lower pore volume but higher Young's modulus and stress values compared to unfilled samples.

II. RESEARCH METHODOLOGY

Materials Used

The reagents used include: chloroform, ethanol, petroleum ether, concentrated sulphuric acid, acetic acid, acetic anhydride, glycerol and ethylene glycol were obtained from the British Drug House. Honsfield Tensometer was used for mechanical property testing.

Gum Arabic Extraction

Gum Arabic exudates was hydrated in double strength chloroform water, precipitated in 95% ethanol and then washed with diethyl ether (oluyemisi et al, 2010). Physical and chemical modification of the gum was carried out according to the method described by Sawumi, (1990).

PVC Formulation

Different proportions of test samples and PVC by weight were weighed to give different compositions by percentage: (PVC: GA), 100%:0%, 90%:10%, 80%:20%, 70%:30%, 60%:40%, 50%:50%, 40%:60%, 30%:70%, 20%:80%, and 10%:90%. Each of these formulations was used for film casting using tetrahydrofuran, (THF) as solvent.

Film Casting

Each formulation was prepared in 30cm³ of tetrahydrofuran. The resulting solution was stirred vigorously and allowed to stand on a water bath for 30 minutes while stirring before it was poured in to a clean dry 8.50cm Petri dishes. The dishes were kept on a flat surface in a fume cup board and allowed to stand for the solvent to evaporate. The film were removed by pouring distilled water sufficiently enough to cover the film surface and allowed to stand for few minutes after which it was removed using spatula. Thereafter, the films were dried by blotting then between filter papers and allowed to dry in a dessicator for 48 hours before taken for mechanical property testing.

Percent Water Absorption

This was carried out according to ASTM D570. The specimens were dried in an oven for 24hours at 50°C and then placed in a dessicator to cool. Immediately upon cooling the specimens were weighed. The materials were then immersed in water at 25°C for 24hours. Specimens were then removed, patted dry with lint free cloth and weighed.

$$\text{Percentage water absorption} = \left[\frac{(\text{wet weight} - \text{dry weight})}{\text{dry weight}} \right] \times 100$$

Mechanical Property Testing

Honsfield tensometer testing machine was used for this determination by the method of ASTM D-882. From the plot of stress-strain curves, the ultimate tensile strength, modulus of elasticity and elongation at break for each film was calculated.

Stress at break was evaluated using the following equation;

$$\tau_b = \frac{F}{A}$$

Where A is the cross-sectional area of the sample and F is the applied tensile force. The elongation at break was calculated using the following equation.

$$\Delta L_b = \left(\frac{L' - L_0}{L_0} \right) \times 100$$

Where, L' is the length of the sample at break and L₀ is the initial length. The modulus of elasticity was evaluated using the equation below.

$$\epsilon = \frac{\tau_y}{(L - L_0) / L_0}$$

Where L is the length of sample at yield and τ_y is the stress at yield (Elgozali and Hassan, 2008).

III. RESULT AND DISCUSSION

Water Absorption

The water absorption test shows that ACT modified gum absorbs water the most as shown in Fig 1. The next to it is EGL, followed by AAN. At 10/90, 20/80% and 30/70% (PVC/GUM) ratio, AAN samples have the lowest water absorption. However at higher compositions of gum, PGM

samples showed lower absorption values than AAN. At 50/50%, ACT and PGM showed a drop in absorption. Generally, the result shows that the water absorption of the formulations increases with increasing concentration of gum sample. This behavior was expected since the water absorption of these formulations is mainly due to the presence of the gum; because the PVC matrix absorbs little water while the gum Arabic contains numerous hydroxyl groups (-OH), which are available for interaction with water molecules by hydrogen bonding. The fact that water absorption was observed, this suggests that the gum Arabic satisfactorily encapsulated the water in the PVC matrix, suggesting that no significant changes occur in the microstructure of the composite.

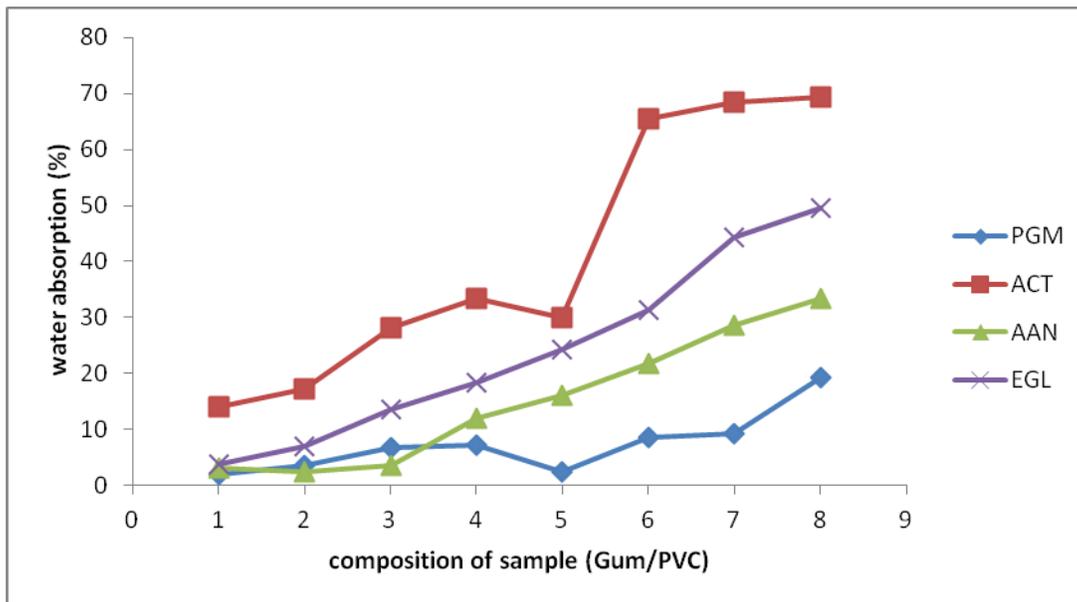


Fig 1: percent water absorption of test samples at various composition.

Mechanical Properties

Mechanical properties were carried out to study the tensile properties of polymer blend films and they become important as polymer technology moves from laboratory into process development. It is well known that mechanical properties might be used to assess the miscibility in polymer blends through a comparison of experimental results and predictions based on various models. Indeed, the mechanical properties of polymer blends depend on the intermolecular forces, chain stiffness, and

molecular symmetry of the individual polymers used to prepare the blend (Mudigoudra et al, 2012).

Tensile strength

The tensile strength of the three modified gums show different results from that of the pure gum arabic. This is revealed in fig 2. The tensile strength of the pure gum (PGM) records 18.8 at 90%/10% PVC/gum, it drops to 14 at 80%/20% PVC/gum and rises again to 16 at 70%/20% PVC/gum. It then continues to drop as the percentage of the gum increases tending

towards zero. In EGL sample, 20.5 was recorded as the highest strength at 90%/10% PVC/gum. The value drops to 14.2 at 80%/20% PVC/gum and increases again to 16.9 at 70%/30%. The tensile strength decreased afterwards as the percent composition of the gum increases. ACT and AAN modified materials increases with the addition of gum to the PVC matrix and increases as the amount of gum increases to a point in which the PVC can no longer support the gum. This is where the tensile properties of the formulations begin the drop, approaching zero. The results shows that there is an increase in the polymer chain length, and also cross linking of the polymer chains as the amount of modified gum increases, forming a system of interpenetrating network (IPN). This was responsible for the increase in the tensile strength as observed, whereas, PGM and EGL shows a decrease in tensile strength as the amount of the filler is increased. The plasticizer forms links with the PVC molecules and acts as a spacer between molecules of the PVC. Due to this linkage, gum Arabic has a positive effect on the mechanical properties of the polymer. It was stated that dipole interaction which occurs between polar groups of chlorine atom in PVC resin and free hydroxyl, ester, amino, etc groups in gum Arabic stand for polar group in the plasticizer. The bond forces of the polymer atoms strengthened due to the linkage established and thus free volume decreases with the addition of gum Arabic to the polymer which leads to increasing tensile strength. In the above cases, it shows that the tensile strength of the materials increases with increase in the amount of gum Arabic; this is attributed to its polarity which increased the cohesive energy density, such that the materials tend to be held together more tightly resulting in induced mobility and flexibility.

The expected results from the chemical modifications are based on the fragmentation pattern from the gum Arabic after chemical treatment. The stress-strain curve exhibited by the gum Arabic could be linked to its relatively high molecular weight in addition to the rigid backbone. Possession of branch linkages would also add to the rigid nature of the gum. The result of this is that when cast into a film, it is very brittle and thus its main drawback in adhesion formulations. Therefore it is believed that

scission of these linkages might result in low molecular weight structures which will reduce the rigidity inherent in the structure. There are two main structural linkages that are susceptible to bond scission. These are the main backbone chain of (1-3) linked D-galactopyranose units and the branching or substitution of these units at the C-6 position with various side chains.

The branch (1-6) linkages are, however, easily broken by acetolysis. The acetolysed gum Arabic was observed to exhibit lower values of tensile strength than pure gum arabic. This may be because scissions in the acetolysed system occurred at branch points. The effect is debranching which results in reduction of chain rigidity and proper re-alignment of molecules.

The result observed for the acetate derivative (AAN) of the gum Arabic also showed debranching of the chains. The effect is, however, more pronounced than the acetolysed samples, probably because of the acetate group. The re-alignment of the molecules with the polar nature of acetate group might have increased the intermolecular force of attraction, the result of which is tougher material than the untreated gum Arabic also. It is therefore suggested that the acetate group is capable of increasing the modulus of rigidity and increase the strain at break of the gum Arabic.

From the result also, EGL being a physically modified gum has a similarity in trend with the pure gum sample. While the chemically modified gums i.e ACT and AAN are also similar in trend. The presence of PVC is believed to increase the strength of the blend due to interlocking of the polymeric chains as well as the dipole-dipole interaction between O-H groups in the gum samples and C-Cl groups in PVC (Kim et al, 1997)

The results have shown that the structure-property typical of the unplasticized gum Arabic can be modified by the addition of plasticizing agents. The effect of the chemically modified additives was significant in the increase in values for ultimate tensile strength to a maximum value before decreasing. While the physically modified sample (EGL) does not show this property.

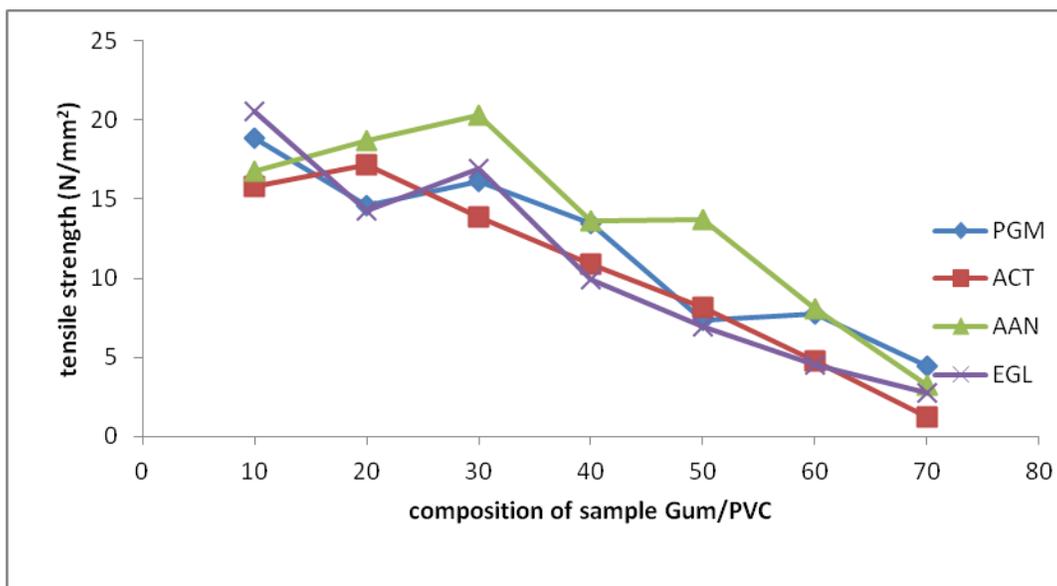


Fig 2: tensile strength of test samples at various compositions.

Elastic Modulus

The tensile stress data show the maximum stress supported by the plastics. The tensile stress decreased as the gum Arabic content increased. Fig 3 gives the elastic Young's modulus of all the test samples. This implies that the modified gums have improved upon the pure gum Arabic. The AAN modification has the highest elastic modulus of 180.15N/m² at 10/90 gum/PVC and it becomes fairly constant at 30/70 and

40/60 gum/PVC composition. ACT is the next with 177N/m² at 10/90 gum/PVC ratio but it begins to drop as the gum concentration increases except at 30/70 gum/PVC composition where it shows a slight increase. The value for EGL records 164, still a higher value than the pure gum samples. It can be observed that the sample with the best modulus is AAN and the composition that showed good elastic behavior is 30/70 gum/PVC.

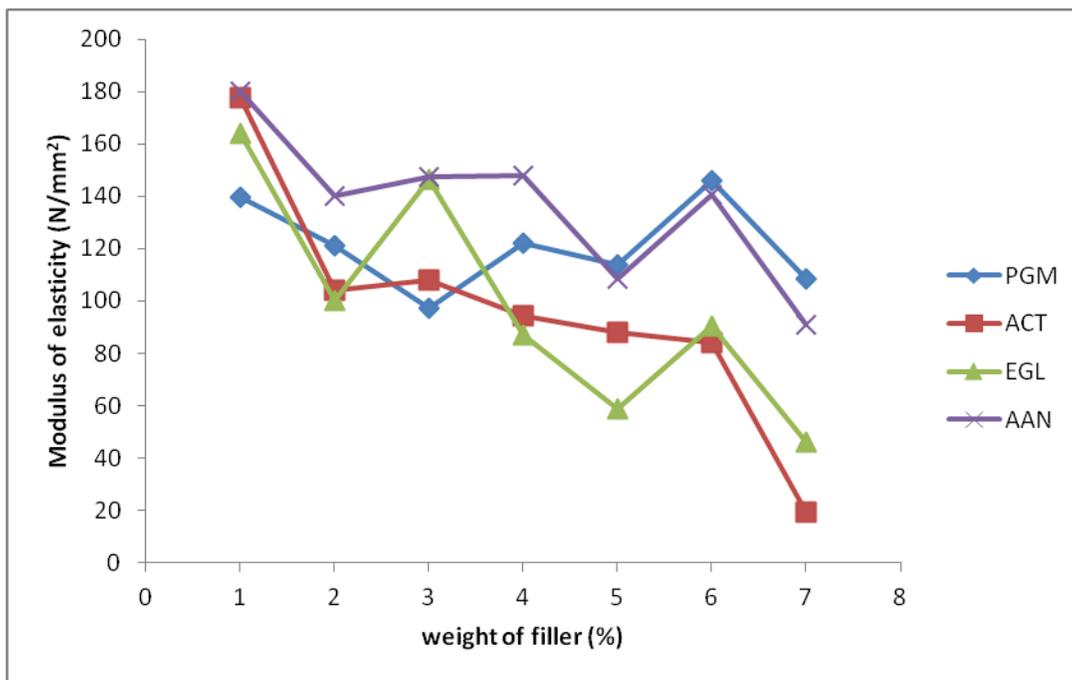


Fig 3: modulus of elasticity of the test samples at varying weight percent of filler

Percentage Elongation of the Samples

Fig 4 shows comparison between pure gum sample and gum modification formulations at different compositions. At 10/90 and 20/80 gum/PVC all modified gums have higher values than the pure gum Arabic. At 30/70 however the pure gum Arabic records 17.8% while all other samples record values

below that. At 50/50%, similar values of 12 and 12.3% were recorded for PGM and AAN, respectively. On comparison, the percent elongation of test sample depends on the composition, though chemically modified formulations show similarity in trend.

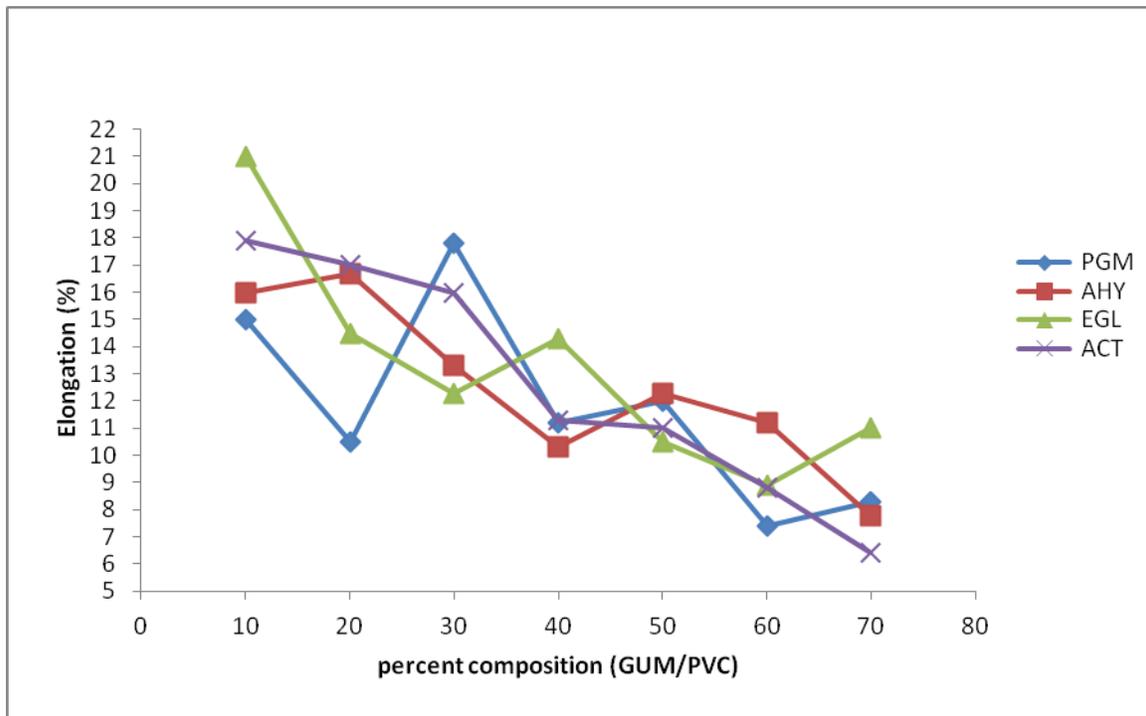


Fig 4: percent elongation of the test samples at varying composition

IV. CONCLUSION

Water absorption results of the samples show ACT has the highest *water absorption capacity*. There are fluctuations in absorption depending on the composition of the sample, but the general trend is that absorption increases with increasing gum concentration. The AAN sample has the highest modulus at 10, 20, 30 and 40% gum composition. For PGM the modulus drops from 10-30% gum composition then finally increases. The ACT modification shows decrease in modulus as the percent of gum increases. Modulus of PGM drops at 20, 40, 60 and 80% gum composition. This study revealed that the tensile strength of the chemically modified formulations shows similarity in trend, while the physically modified formulation also shows similarity in trend with the pure gum formulation. ACT and AAN formulations show high strength at 10%/90%, 20%/80% and 30%/70% for AAN and 10%/90% and 20%/80% for ACT before generally decreasing. This was not the case for EGL and PGM formulation which show decrease in tensile strength as the composition of gum increases. On comparative effectiveness, the chemical modifications showed reinforcement in the PVC matrix, while the physical modification showed plasticizing property due to decrease in tensile strength as the percentage of gum increases. The AAN sample at 30%/70% Gum/PVC composition was found to be the strongest with overall best adhesive property.

REFERENCES

[1] Blanco, A. (2000). Polyolefins: Mergers & Acquisitions Define the Future. Society of Plastic Engineers. 56(5): 41.
[2] Charles, E. W., James, W. S., Charles, A. D., and Mark, T. B., (2005), "PVC Handbook", Published by Hanser Verlag, Munich, London. 95-244.

[3] Demir, H. Sipahioglu, M. Balkose, D. and Ulku, S. (2008), "Effect of Additives on Flexible PVC Foam Formation", Journal of Material Processing Technology, volume 195, 144-153.
[4] Elgozali A. and Hassan M. (2008), Effects of Additives on the Mechanical Properties of Polyvinyl Chloride. Journal of Science and Technology, volume 9, No. 1 pp. 1-12.
[5] Harris, W. D. (1969), "Measurement of Tensile Properties of Polymers", In W. E. Brown (Ed), Testing of Polymers, volume 4, Inter Science Publication, New York.
[6] Labib, M. E. and Williams, R. (1984), The Effect of Processing Additives on the Surface Properties of Polyvinyl Chloride, Journal of Colloids and Polymer Science, volume 37(5), pp. 340-349.
[7] Liu, Y. and Zhang, C. (2007), "The Influence of Additives on Crystallization of Polyvinyl Chloride", Journal of Wuhan University of Technology, Material Science, volume 22(2), 271-275.
[8] Mamza, P. A. P. and Solomon, C. I. (2008), "Stabilization of Polyvinyl Chloride (PVC) and Effects of Acid/Base on the Mechanical Properties of PVC", Journal of Research in physical Science, volume 4, No. 2. 55-105.
[9] Mascia L. (1974), The Role of Additives in Plastics, Edward Arnold, London. pp. 1-5.
[10] Sawumi S. (1990), "Modification of Gum Arabic" MSc Thesis submitted to the Department of Chemistry, Ahmadu Bello University, Zaria pp 18-21.
[11] Mudigoudra B. S., Masti S. P. and Chougale R. B., (2012), "Investigation of Mechanical Properties of Ternary Polymer PVC/PAVc/PEG Blended Films", Research Journal of Engineering Sciences Vol. 1(2), 63-65.
[12] Oluyemsi A. B., Vivek R. S., Ruchita K and Oluwatoyin A. O, (2010) "Characterization and Evaluation of Terminalia randa gum as a Binder in Carvedilol Tablet Formulation", Acta pharmaceutica scientifica 52: 254-262.
[13] Titov, W.V. (1984), PVC Technology, 4th edit., Elsevier Applied Science, London.

AUTHORS

First Author – Sani I. Alhassan, Department of Chemistry
Kano University of Science and Technology, Wudil, Kano
Nigeria., Email: saniidris2012@gmail.com

Second Author – Paul A. P. Mamza, Department of Chemistry
Ahmadu Bello University Zaria, Kaduna Nigeria.

Third Author – Aliyu M. Ja’o, Department of Chemistry
Federal University Kashere, Gombe State.

Ability of Gamma Radiation to Detoxify Black-necked Spitting Cobra (*Naja Nigricollis*) Snake Venom

Fatma Y. Abdou**, Ezz El Din El Denshary*, Esmat A. Shaaban** and Marwa A. Mohamed**

*Department of Pharmacology and Toxicology – Faculty of Pharmacy- Cairo University

**Department of Drug Radiation Research – National Center for Radiation Research and Technology – Atomic Energy Authority

Abstract- In the current study, the lethality as well as the immunological, biochemical and histological effects of *Naja nigricollis* (Black-necked spitting cobra) venom at a sublethal dose has been investigated before and after exposure to gamma radiation (1.5KGy and 3KGy). Data revealed that the toxicity of irradiated venom (1.5KGy & 3KGy) decreased as compared to that of the native one. The LD₅₀ for native and gamma-irradiated (1.5KGy & 3KGy) *Naja nigricollis* venom was 0.440 mg/kg, 4.79 mg/kg and 5.38 mg/kg, respectively. Irradiation of the whole venom with (1.5kGy & 3kGy) reduced its lethality 10.8 and 12.22 times as compared to its native venom, respectively. The immunodiffusion technique showed same number of precipitin bands against polyvalent antivenin with the native and the two dose levels gamma-irradiated venoms. There was no change in the antigenic reactivity between both native and irradiated *Naja nigricollis* snake venom. As for the biochemical responses of *Naja nigricollis* venom, the effect of half LD₅₀ of native or irradiated (1.5KGy) was studied on the activities of heart enzymes: CPK, CK-MB, LDH and AST after (1, 2, 4, 24 hours) of envenomation. The present study showed that snake venom envenomation caused significant ($p \leq 0.05$) elevation in serum CPK, CK-MB, LDH and AST levels. In contrast, the 1.5KGy gamma-irradiated *Naja nigricollis* venom recorded no significant changes compared to that of the non envenomated normal rats. These results are in accordance with the histological findings of the heart that showed severe degeneration of the cardiac muscle with loss of striations and extensive haemorrhage inbetween the myocardial bundles. These results indicate that 1.5KGy gamma irradiation of venoms offer an effective method for reducing the chronic toxic effect of venom in immunized animals for preparing the best toxoids and vaccines, facilitating antisera production and extending the useful life of immunized animals.

Index Terms- double immunodiffusion, gamma radiation, heart enzymes, *Naja nigricollis*, snake venom.

I. INTRODUCTION

Snakebite is a serious medical problem worldwide, especially in the tropics. The incidence of snakebite mortality is particularly high in Africa, Asia and Latin America (Gutierrez et al., 2006). In Africa, snakebites cause more than one thousand deaths each year and thousands of cases of permanent physical disability (Theakston et al., 2003). In Egypt, the Black-necked Spitting Cobra; *Naja nigricollis* (*N. nigricollis*) is one of the most venomous snakes distributed in the south part of Egypt (Saleh, 1997). Snake venom is a complex mixture of many substances,

such as toxins, enzymes, growth factors, activators and inhibitors with a wide spectrum of biological activities (Mady, 2002; Badr et al., 2012). They are also known to cause different metabolic disorders by altering the cellular inclusions and enzymatic activities of different organs. Snake bite is an important cause of mortality and morbidity. Elapidae family such as *Naja nigricollis* is characteristic of the African spitting cobras. Its' venom retains the typical elapid neurotoxic properties while combining these with cytotoxins. The lethal effect of cobra bites is mainly neurotoxic. This is explained by the presence of highly potent α -neurotoxin in their venoms (Meenatchisundarama & Michael, 2010). The myocardial effect of snake venoms is considered as one of the most common pathogenesis in many cases of snake envenomation (Saadeh, 2001; Maheshwari & Mittal, 2004; Gaballa et al., 2005). To improve antisera production and extend the useful life of immunized horse much effort has been devoted to decrease chronic venom toxicity. Towards more effective and safer antivenins, one method that has been shown to be venom toxicity effective for attenuating venom toxicity while maintaining its' immunogenicity is gamma irradiation (Shaaban, 1990; Shaaban et al., 1996; Clissa et al., 1999; Souza et al., 2002; Oussedik-Oumehdi & Laraba-Djebari, 2008). The aim of the present study was to evaluate the effectiveness of gamma irradiation using 1.5KGy in the detoxification of *Naja nigricollis* snake venom without affecting their immunogenic properties. This was carried out by studying the toxicological, immunological, biochemical and histological parameters induced by envenomation.

II. MATERIALS AND METHODS

Animals

White male Swiss albino mice, weighing 20-25 g were used for LD₅₀ study. Also adult male Wister albino rats, weighing 120-150 g, were used. Mice & rats were obtained from the Institute of Ophthalmology (Giza, Egypt). The animals were kept under suitable laboratory conditions of temperature, humidity and light throughout the period of investigation. They were allowed free access to food consisting of standard pellets obtained from El-Nasr Chemical Company (Cairo, Egypt) and water ad libitum. The study was carried out according to the approval of Ethics Committee for Animal Experimentation at Faculty of Pharmacy, Cairo University and in accordance with the guidelines set by the EEC regulations (revised directive 86/609/EEC) at the National Center for Radiation Research and Technology.

Venom

Naja nigricollis venom was obtained from laboratory unit of Medical Research Center, Faculty of Medicine, Ain Shams University. The venom was obtained by milking healthy snake, dried and kept in desiccators at 4°C till used.

Antivenin

Egyptian polyvalent antivenin prepared against *Cerastes cerastes*, *Echis pyramidum*, *Naja haje*, *Naja nigricollis*, *Cerastes vipera* and *Echis carinatus* obtained from the Egyptian Organization of Biological Products and Vaccines, Agouza, Cairo, Egypt, (VACSERA) was used. The polyvalent antivenin produced in horses was kept at 4°C till used.

Irradiation of the venom

The venoms were irradiated with 1.5K Gy and 3K Gy gamma rays in the National Center for Research and Radiation Technology, Cairo, Egypt, using cobalt-60 Indian gamma cell (GE 4000A). The radiation dose rate was 1.26 Gy per second. In this study, a saline solution of *Naja nigricollis* snake venoms were subjected to integral radiation dose levels (1.5 and 3K Gy).

Lethality

Toxicity of *Naja nigricollis* snake venom was studied before and after exposure to 1.5K Gy or 3K Gy gamma radiation. The LD₅₀ was determined according to the method of Spearman and Karber (*WHO, 1981*) by intraperitoneal (i.p) injection of the venom in different doses into swiss albino mice. Six mice were used for each dosage. The LD₅₀ was determined from the formula:

$$M = X_k + \frac{1}{2} \frac{d - dr}{N}$$

M=log LD₅₀

X_k= log dose causing 100% mortality (log LD₁₀₀).

d=logarithmic interval of doses.

r =Sum of the number of animals dead at each of the individual doses.

N=Number of animal in each group.

Immunodiffusion technique

Double immunodiffusion technique was carried out as described by *Ouchterlony (1948)*. They were carried out using 1.7 Nobel Agar (Difeco. Lab. Detroit. Mich.) in 0.9% NaCl solution, sodium azide was added in a concentration of 0.05%, to retard bacterial growth. The wells were filled with 20 µl volumes. The venom samples in concentration of (20 mg/ml) were added in the peripheral wells, while the antivenin was added in the central well. After developing of the precipitation bands (48 h), the plates were washed for 24 h in saline, dried and stained using Amidoschwartz stain 10B (0.5 % in 5 % acetic acid) for 7 min, washed with methanol acetic acid (9:1) dried in air and photographed.

Experimental Design

Mice were used for determination of median lethal dose (LD₅₀) of native and gamma-irradiated (1.5K Gy and 3K Gy) *Naja nigricollis* snake venoms.

Mice were divided into three sets as follows:

Set 1: was used to determine the LD₅₀ of native *Naja nigricollis* venom.

Set 2: was used to determine the LD₅₀ of 1.5K Gy gamma-irradiated *Naja nigricollis* snake venom.

Set 3: was used to determine the LD₅₀ of 3K Gy gamma-irradiated *Naja nigricollis* snake venom.

Each set was subdivided into several groups and each group included six animals, according to the method of Spearman & Karber for LD₅₀ determination (*Finney, 1964*). The 1.5K Gy γ-radiation is the selected dose to carry out the biochemical experiments of the present study, as it gets rid of venom toxicity while maintains immunogenicity.

ii. Rats were used for measuring the biochemical parameters; the equivalent rat dose was calculated according to *Paget & Barnes (1964)* to be used in the following biochemical experiments. Half value of LD₅₀ of native and 1.5K Gy irradiated *Naja nigricollis* venom were the selected doses to carry out the biochemical experiments of this study in rats. The animals were classified into three groups each group included eight rats and were treated as follows:

Group I: received 0.3 ml saline i.p injected and served as normal non-venomated.

Group II: received native *Naja nigricollis* snake venom (0.154 mg/kg) i.p injected.

Group III: received gamma-irradiated (1.5K Gy) *Naja nigricollis* (1.67 mg/kg) i.p injected.

Rats in groups (I, II and III) were sacrificed by decapitation (1, 2, 4, 24 hours) respectively after venom injection.

Determination of cardiotoxicity of native & irradiated (1.5K Gy) *N. nigricollis* venom

Determination of serum creatine kinase (CK) according to (*Szasz et al., 1976*), serum isoenzyme creatine kinase-MB (CK-MB) was determined according to the method of the **IFCC, (1989)** while lactate dehydrogenase was determined according to the method of (*Wacker et al., 1956*) and aspartate aminotransferase (AST) activity. AST was determined in serum colorimetrically according to the method of (*Reitman & Frankel, 1957*). Enzymatic activity was expressed as units per liter.

Histopathological Study

Following the animals being sacrificed the abdomen was opened, the specimens from heart of experimental rats were collected and immediately fixed in 10% formalin solution, kept until become hard enough to be sectioned. Samples were embedded in paraffin blockers. Sections of 5 µm were obtained and stained with Hematoxylin and Eosin (H&E) for standard histological examination using light microscope according to the method of (*Bancroft & Stevens, 1996*).

Statistical Analysis

Values were calculated as mean \pm standard error (S.E) of the mean. Comparisons between different groups were carried out by one way analysis of variance = (ANOVA) followed by Tukey-Kramer multiple comparison test, using Instant software, version 3 (Graph pad software, Inc., San Diego, USA). The P value was set at ≤ 0.05 .

The figures were drawn using instant software program (Microsoft Office Excel 2010).

III. RESULTS AND DISCUSSION

1- Lethality

The LD₅₀ for native and gamma-irradiated (1.5KGy & 3KGy) *Naja nigricollis* venom was 0.440 mg/kg, 4.79 mg/kg and 5.38 mg/kg, respectively. Toxicity of gamma-irradiated venom was reduced 10.8 and 12.22 times as compared to the native venom, respectively. Table (1) showed the LD₅₀ of *Naja nigricollis* venom before and after irradiation by 1.5KGy and 3KGy at 95% confidence limits. There was a dose dependent increase in the LD₅₀ after gamma irradiation and decrease in the toxicity of *Naja nigricollis* venom.

Snake bite envenomation is an important neglected disease in many tropical and subtropical developing countries (Warrell, 1993; Chippaux, 1998; Kasturiratne et al., 2008), most severe cases of snake bite envenomation are inflicted by species of the family Elapidea and the family Viperidea (Gutierrez et al., 2006). In the present study, the LD₅₀ of the *Naja nigricollis* venom was found to be 0.440 mg/kg, whereas toxicity of gamma irradiated (1.5KGy & 3KGy) *Naja nigricollis* venom was reduced 10.8 and 12.22 times as compared to its native venom, respectively. Thus, progressive dose dependent increase in the LD₅₀ after gamma irradiation indicates decrease in toxicity of *Naja nigricollis* venom. The present result agrees with Murata et al., (1990) who showed that irradiation with 2000Gy crude venom of *Crotalus durissus terrificus* was the ideal irradiation dose, promoting venom detoxification with maintenance of its immunogenicity. Souza et al., (2002) investigated the ability of gamma radiation from ⁶⁰Cobalt (2 KGy) to attenuate the toxic effects of *Bothrops jararacussu* venom. It was concluded that ⁶⁰Co gamma radiation is able to abolish toxic effects of *Bothrops jararacussu* venom. Also, Shaaban, (2003) showed that irradiated *Naja haje* and *Cerastes cerastes* venoms were 28.1 % and 30.8 % less toxic respectively than the native ones. In addition, these results were in accordance with results of Abib & Laraba-Djebari (2003) who reported that the toxicity of irradiated *Cerastes cerastes* venoms (1 and 2KGy) decreased as compared with that of native venom. Similar researches on influence of identification of gamma radiation on venom of snakes (*Cerastes cerastes*, *Bothrops jararacussu* and others) are given in researches of some authors. After irradiation of poison of snakes to gamma radiation ⁶⁰Co to doses 1 and 2kGy, decrease in toxicity of venom was noted. However decrease in immunogenic properties of toxins of snake poison was not noted. Authors revealed changes of spectral characteristics of the irradiated samples of toxins (Boni-Mitake et al., 2001; Oussedik-Oumehdi & Laraba-Djebari, 2008; Jessica et al., 2009). Moreover, Bennacef-Heffar & Laraba-Djebari (2003) showed that the effect of gamma irradiation on the venom of *Vipera lebetina* (one of the two widespread snakes in Algeria).

Vipera lebetina venom was irradiated with two doses of gamma rays (1 and 2 KGy) from a ⁶⁰Co source, and the venom's toxic, enzymatic, and structural properties were analyzed. Intraperitoneal injection of the irradiated venoms (100–500 μ g/20 g mouse body mass) revealed a significant decrease in its toxicity. Irradiated venoms with 1 and 2KGy doses were four and nine times less toxic, respectively, than the native venom. These results indicate that irradiation of *V. lebetina* venom with a dose of 2KGy can promote a significant detoxification, keeping the immunological properties intact. Both chromatographic and electrophoretic profiles of the irradiated venom were drastically changed as compared with that of the native venom (Shaaban et al., 2010). Loss of function of protein by irradiation is not usually due to breaking peptide bonds, or otherwise, disrupting the primary skeletal structure of peptide chain. It may result from a break in the hydrogen or disulfide bonds which in turn can result in a disorganization of the internal relationships of side chain groups, or an exposure of amino-acid groups, resulting in change in biological activity (Hayes & Francis, 2001).

It was well known that the doses of the order of kilograys used in detoxification of the venom influenced both the physiochemical properties and the biological activity of macromolecules, when irradiated in aqueous media or even in the solid state (Antoni, 1973; Hayes & Francis, 2001), since there is a close interrelationship between the structure and the biological activity of macromolecules, some alteration appeared to be the most possible explanation for the radiation effects.

Table (1): LD₅₀ for Native, 1.5kGy and 3kGy Gamma-Irradiated *Naja nigricollis* Snake Venom:

Venom	LD ₅₀ (mg/kg)	95% Confidence limits
Native <i>Naja nigricollis</i>	0.44	0.42 \pm 0.46
Irradiated (1.5KGy) <i>Naja nigricollis</i>	4.79	4.04 \pm 5.69
Irradiated (3KGy) <i>Naja nigricollis</i>	5.38	4.91 \pm 5.92

2-Immunodiffusion technique

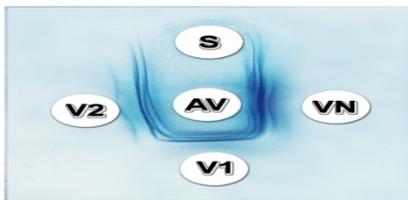
The result of double immunodiffusion test of native, 1.5KGy and 3KGy gamma irradiated venoms against the commercial polyvalent Egyptian antivenin, showed similar precipitin patterns using venom concentration of 20 mg/ml. Only faint bands were seen with a concentration of 10 mg/ml of *Naja nigricollis* snake venom. Exposure to 1.5KGy or 3KGy gamma radiation did not affect the immunological properties of the used snake venom.

Visible lines were observed with the non- irradiated, as well as, the two dose levels gamma-irradiated (1.5KGy and 3KGy) *Naja nigricollis* snake venom (fig. 1). These visible lines were identical, continuously joined smoothly at the corners, indicating that there was no change in antigenic determinants.

These results demonstrate that the ability of the venom antigens to react with its corresponding antibodies was maintained in spite of being exposed to radiation doses of 1.5KGy and 3KGy.

The present results showed that the antigenic response was not changed as judged by the capacity of irradiated venom to react with the antivenin. The immunodiffusion technique showed identity between native and irradiated samples. These results are in agreement with the data of other studies that reported that ionizing radiation is able to detoxify *Androctonus amoreuxi* without affecting the immunogenic properties (Shaaban, 1990). Also, the recorded results are in accordance with those concluded by Shaaban et al., (1996). This indicated that, there was no change in the antigenic reactivity of native, 1.5KGy and 3KGy for *Naja nigricollis* snake venom.

Furthermore, Nascimento et al., (1998) reported that ionizing radiation is able to detoxify several venoms, including snake venoms, without affecting their immunogenic properties significantly. It has been shown that gamma irradiation is an effective technique for attenuating venom toxicity and maintaining venom immunogenicity (Shaaban, 2003; Abib & Laraba-Djebari, 2003). Irradiation of *Vipera lebetina* venom with a dose of 2KGy can promote a significant detoxification while keeping the immunological properties intact (Shaaban et al., 2010).



- S = Saline.
- AV= polyvalent antivenin.
- VN=Native *Naja nigricollis* venom.
- V1 = 1.5KGy irradiated *Naja nigricollis* venom.
- V2 = 3KGy irradiated *Naja nigricollis* venom.

Figure (1): Immunodiffusion Reaction of Horse Serum Polyvalent Antivenin with Native, 1.5KGy and 3KGy Gamma-Irradiated *Naja nigricollis* Venoms.

3-Effect of ½ LD₅₀ of Native & Gamma-Irradiated (1.5KGy) *N. nigricollis* Snake Venoms (0.154 mg/kg i.p) and (1.67 mg/kg i.p) respectively on Heart Enzymes (CK, CK-MB, LDH & AST) Activities in Male Albino Rats

In the present study, a dose of 1.5KGy gamma rays was selected, showing significant increase in LD₅₀ for *Naja nigricollis* snake venom. The results are shown in Table (2) and illustrated in Figures (2), (3), (4) and (5):

CPK levels of normal (non-envenomed) rats were 444.10±25.43, 371.60±18.86, 478.10±42.14 and 833±54.96U/L after (1, 2, 4, and 24) h respectively. *Naja nigricollis* native venom in a dose equal to ½ LD₅₀ (0.154 mg/kg) showed highly significant elevation in CPK levels by 63%, 240.2 %, 132.3%

and 71.30 % compared to the normal group after (1, 2, 4, 24) h respectively. Gamma-irradiated (1.5KGy) *Naja nigricollis* venom groups did not cause any significant change in CPK levels after 1 & 4 h, but significant increase was observed in CPK levels by 46.20 % & 28 % after 2 & 24 h respectively compared to non-envenomed control.

As regard to CK-MB levels of non-envenomed rats were 576±47.76, 451.30±33.18, 398±15.30 and 673.2±45.92 U/L after (1, 2, 4, and 24) h respectively. *Naja nigricollis* native venom in a dose equal to ½ LD₅₀ (0.154 mg/kg) showed highly significant elevation in CK-MB levels by 67.46 %, 82 %, 81 % and 78.7% compared to the normal group. Gamma-irradiated (1.5KGy) venom groups did not cause any significant change in CK-MB after 1 & 4 h, but significant increase was observed in CK-MB levels by 37.3 % & 32 % after 2 & 24 h respectively compared to non-envenomed control.

However, LDH levels of normal rats were 893.5± 61.01, 902.7±41.66, 962.2 ±28.76 and 898.1±4.60 U/L respectively. The group injected i.p. with native *Naja nigricollis* venom in a dose equal to ½ LD₅₀ did not cause any significant change in LDH after 1, 2 & 4 h, but showed significant increase in LDH level by 46.2 % after 24 h compared to the normal group. Also, gamma-irradiated (1.5KGy) *Naja nigricollis* venom groups did not cause any significant change in LDH levels.

AST levels of normal rats were 103.4±2.21, 99.11±2.35, 101.3±0.87 and 102±0.69 U/L respectively. *Naja nigricollis* native venom did not cause any significant change in AST levels compared to control after 1 & 2 h, while showed highly significant elevation in AST level by 32.4 % & 27 % after 4 & 24 h respectively compared to the normal group. Also, gamma-irradiated (1.5KGy) venom groups did not cause any significant change in AST levels compared to non-envenomed control.

The impact of γ-irradiation on *Naja nigricollis* snake venom induced changes on some biochemical markers. As for the effect on heart enzymes, the present study indicated that injection of native *Naja nigricollis* snake venom in a dose equal ½ LD₅₀ (0.154 mg/kg i.p) caused a highly significant increase of Aspartate aminotransferase (AST), Lactate Dehydrogenase (LDH), Creatine Phosphokinase (CPK) and Creatine Phosphokinase isoenzyme (CK-MB) compared to the normal control. The obtained results are in agreement with those previously reported by other investigators. Tresseler (1988) mentioned that elevation in serum AST results from conditions causing injury to cardiac muscle. Also, Fernando et al., (1989) reported that *B. asper* venom caused serum AST, LDH and CPK to increase significantly. Moreover, Aguiyi et al., (2001) reported an elevation in the levels of Lactate Dehydrogenase (LDH) and Creatine Phosphokinase (CPK) following administration of *Echis carinatus* venom.

Shaaban & Hafez (2003) reported that the intraperitoneal injection of a sublethal dose of *Naja haje* venom (0.2mg/kg) in rats induced a significant elevation in the activities of LDH and CK-MB as compared to normal control. Furthermore, Lucas de Oliveira et al., (2007) evaluated the muscular enzymes creatine kinase (CK) and aspartate aminotransferase (AST) and alanine aminotransferase (ALT) following envenomation with natural and ⁶⁰Co-irradiated *bothropic* venom (*Bothrops jararaca*). The authors stated that animals injected with natural venom exhibited serum levels of these enzymes higher than those

observed in animals injected with irradiated venom. In other side, the irradiated venom caused increasing in the serum levels of muscular enzymes CK, AST, and ALT, although animals inoculated with natural venom exhibited higher serum levels of such enzymes.

The obtained results are in accordance with those previously reported by other investigators (*Bhagwat & Amar, 2013*) who studied that serum activities of enzymes (AST), (ALT), (LDH) and (CK) was found to be specifically elevated in patients of snake bite. The increase in serum activities of above enzymes is due to secretion of the enzyme in the serum as a result of muscular damage, (rhabdomyolysis), produced by toxins from venom. AST and CK found elevated due to cardiac as well as skeletal muscle damage. ALT found elevated due to skeletal muscle damage. While LDH increases due to hemolysis and cardiac as well as skeletal muscle damage.

Moreover, *Al-Sadoon et al., (2013)* showed that, mice envenomation with *Cerastes cerastes gasperetti* crude venom at LD₅₀ dose for the 1st, 3rd and 6th hr. caused different changes of the selected biochemical parameters. *Cerastes cerastes gasperetti* crude venom induced a highly significant elevation in serum AST & LDH activities.

Interestingly, gamma-irradiated (1.5KGy) *Naja nigricollis* venom in a dose equal ½ LD₅₀ (1.67 mg/kg i.p.) did not cause any observed significant change in CPK, CK-MB, LDH and AST serum levels compared to non-envenomed control. This was in contrast to the native *Naja nigricollis* venom that induced a highly significant increase of CPK, CK-MB, LDH and AST serum levels compared to the normal control or the 1.5KGy γ -irradiated *Naja nigricollis* venom.

Also, *Shaaban et al., (1996)* recorded that there was non-significant increase following 2KGy γ -irradiated *Cerastes cerastes* and *Echis pyramidum* snake venom. This is attributed to the disorganization of the molecular structure of venom after exposure to gamma radiation resulting in a change in its biological activity (*Hayes, 2001*). Thus, radiation is able to detoxify snake venoms and decrease its harmful effects. In addition, *Abib & Laraba-Djebari (2003)* reported that the creatine phosphokinase (CPK) activity was significantly increased in the serum and decreased in the myocardium after envenomation with native *Cerastes cerastes* venom, but no significant enzymatic changes were observed in mice envenomated with irradiated venom. These results indicate that irradiation of venom with a 2KGy dose may offer an effective method for reducing the chronic toxic effects of venom in immunized animals.

These results were in accordance with results of *Shaaban et al., (2010)* who showed that 1.5KGy γ - irradiated *Echis pyramidum* venom caused a non- significant change (when used at a dose equal to that used for the native venom; 27.69 μ g/mouse) of ALT, AST, LDH, CPK and CK-MB compared to the normal control, while the native *Echis pyramidum* venom (27.69 μ g /mouse) that induced a highly significant increase of ALT, AST, LDH, CPK and CK-MB compared to the normal control or the 1.5 KGy γ - irradiated *Echis pyramidum* venom.

Table (2): Effect of Native & Gamma-Irradiated (1.5KGy) *N. nigricollis* Snake Venoms on Heart Enzymes (CK, CK-MB, LDH & AST) Activities in Male Albino Rats at Different Times:

Parameters	Normal (non-envenomed)	Native <i>N. nigricollis</i> (non-irradiated) (0.154 mg /kg i.p)	Gamma-irradiated (1.5KGy) <i>N. nigricollis</i> (1.67 mg/kg i.p)
CPK (U/L)			
1 h	444.10±25.43	724.10±44.96*	409.50±27.20 #
2 h	371.60±18.86	1264±19.20*	543.30±41.48 *#
4 h	478.10±42.14	1111±41.57*	490.40±40.86 #
24h	833±54.96	1427±65.86*	1064±79.16 *#
CK-MB(U/L)			
1 h	576±47.76	964.6 ±56.58*	469.3±39.55 #
2 h	451.30±33.18	820.9 ±38.26*	619.5±22.23 *#
4 h	398±15.30	719.1±22.61*	517.7±21.53 #
24h	673.2±45.92	1203 ±14.65*	887.1±41.18 *#
LDH(U/L)			
1 h	893.5±61.01	1096±63.39	961.7±49.23
2 h	902.7±41.66	1061±83.37	969.5±45.34
4 h	962.2±28.76	1052±55.25	1056±40.60
24h	898.1±4.60	1313±46.69 *	901.7±23.17 #
AST(U/L)			
1 h	103.4±2.21	103.7±2.79	103.7±4.87
2 h	99.11±2.35	114.1±2.82	108.4±2.31
4 h	101.3±0.87	134.2±4.61 *	108.9±0.19 #
24h	102±0.69	130±1.27 *	107±2.95 #

Three groups of animals each consisting of 8 rats received saline (0.3 ml i.p) served as normal group, native *Naja nigricollis* venom (0.154 mg/kg i.p) and gamma-irradiated (1.5KGy) venom (1.67 mg/kg i.p), blood was collected (1, 2 4, 24) h after envenomation, for estimation of heart enzymes activities.

Each value represents Mean± S.E
Statistical analysis was carried out by one way ANOVA followed by Tukey- Kramer Multiple Comparison Test:

*Significant difference from Normal group ($P \leq 0.05$).

Significant difference from Native group ($P \leq 0.05$).

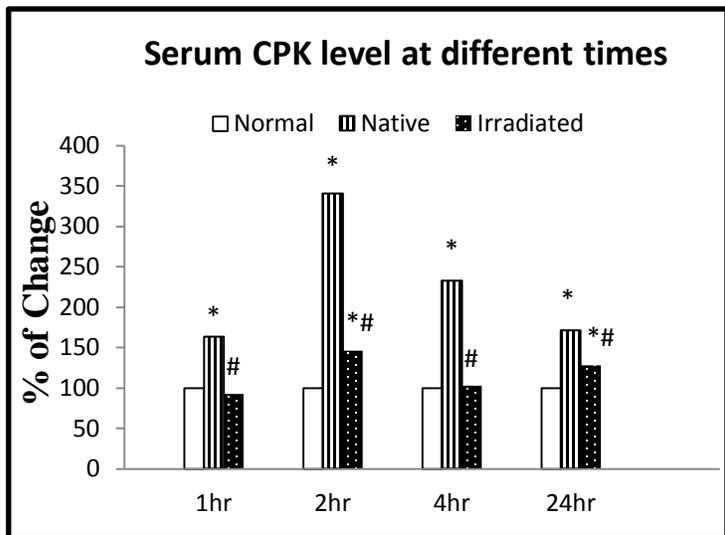


Figure (2): Effect of Native (0.154 mg /kg i.p) & Gamma-Irradiated (1.5KGy) (1.67 mg/kg i.p) *N. nigrlicollis* Snake Venoms on Creatine Kinase (CPK) in Male Albino Rats:

*Significant difference from Normal group ($P \leq 0.05$).
Significant difference from Native group ($P \leq 0.05$).
% of change: The percentage change of control.

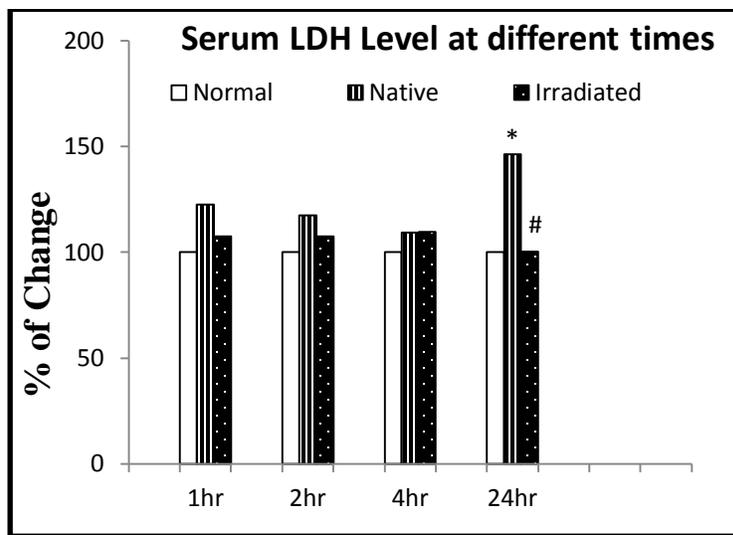


Figure (4): Effect of Native (0.154 mg /kg i.p) & Gamma-Irradiated (1.5KGy) (1.67 mg/kg i.p) *N. nigrlicollis* Snake Venoms on Lactate Dehydrogenase (LDH) in Male Albino Rats:

*Significant difference from Normal group ($P \leq 0.05$).
Significant difference from Native group ($P \leq 0.05$).
% of change: The percentage change of control.

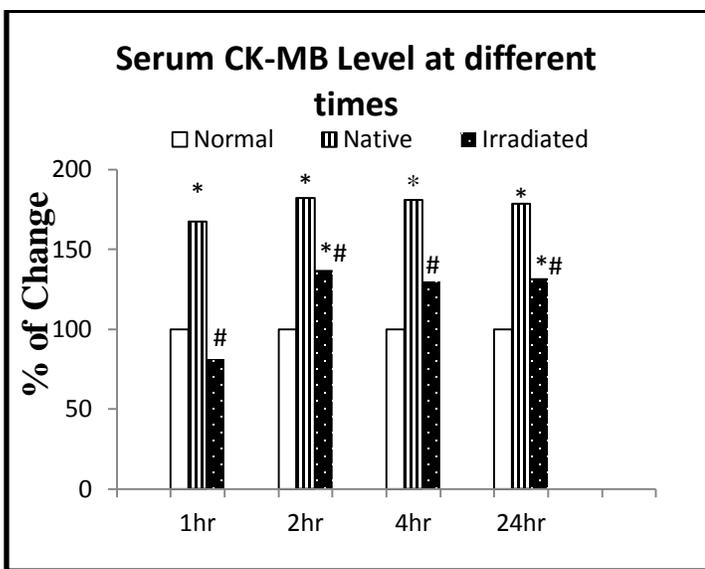


Figure (3): Effect of Native (0.154 mg /kg i.p) & Gamma-Irradiated (1.5KGy) (1.67 mg/kg i.p) *N. nigrlicollis* Snake Venoms on Creatine Kinase-MB isoenzyme (CK-MB) in Male Albino Rats:

*Significant difference from Normal group ($P \leq 0.05$).
Significant difference from Native group ($P \leq 0.05$).
% of change: The percentage change of control.

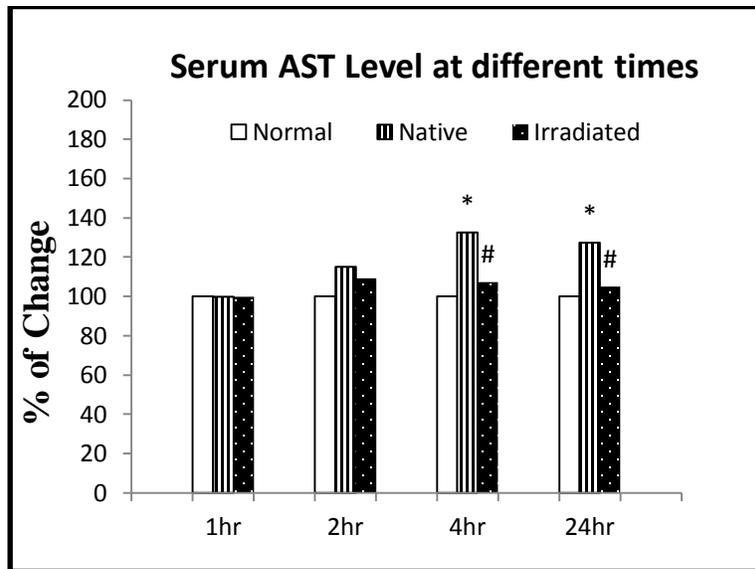


Figure (5): Effect of Native (0.154 mg /kg i.p) & Gamma-Irradiated (1.5KGy) (1.67 mg/kg i.p) *N. nigrlicollis* Snake Venoms on Aspartate Aminotransferase (AST) in Male Albino Rats:

*Significant difference from Normal group ($P \leq 0.05$).
Significant difference from Native group ($P \leq 0.05$).
% of change: The percentage change of control.

Histopathological Study:

Histopathological examination of heart was carried out to adjoin the biochemical changes of heart enzymes. Certain histopathological changes were observed after injection with native and gamma irradiated (1.5KGy) *Naja nigricollis* venom. The effect of native *Naja nigricollis* venom in a dose equal to ½ LD₅₀ (0.154 mg/kg i.p) and gamma-irradiated (1.5KGy) *Naja nigricollis* venom ½ LD₅₀ (1.67 mg/kg i.p) on heart muscle after 24 h envenomation was illustrated as following:

a)- Control group:

Heart of control, untreated rats showing normal appearance of cardiac tissues could be observed in Fig. (I&II) , in these figures, longitudinal section of cardiac muscle illustrating the variable diameter of the fibers and the central position of their nuclei. The ends of the fibers are split longitudinally into a small number of branches the end of which abuts onto similar branches of adjacent cells giving the impression of a continuous three-dimensional cytoplasmic network.

b)- Native venom-injected group:

Heart of rats injected with native venom at a dose of (0.154 mg/kg i.p) exhibited highly degenerated muscle fibers with loss of striations. Also massive extended haemorrhagic areas. Intramuscular oedema and haemorrhage, vacuolation of sacroplasm of cardiac myocytes and inflammatory cells infiltration were apparently seen Figs. (III & IV &V).

c) - Gamma -irradiated (1.5 KGy) venom injected group:

Heart of rats injected with γ - irradiated (1.5KGy) venom at a dose of (1.67 mg/kg i.p) showed restoration of the characteristic myocardium appearance, also showing no histopathological changes, but in some areas, few inflammatory cells between cardiac myocytes were apparently seen Figs. (VI&VII&VIII).

Histological examination demonstrated highly degenerated muscle fibers with loss of striations of cardiac muscles following injection with native *Naja nigricollis* venom in a dose equal ½ LD₅₀ (0.154 mg/kg i.p) after 24 h. Also massive extended haemorrhagic areas, intramuscular oedema, haemorrhage, vacuolation of sacroplasm of cardiac myocytes and inflammatory cells infiltration were observed.

This might be due to a large number of toxins have been isolated, purified and characterized from such venoms including cardiotoxins, cytotoxins (*Jeyaseelan et al., 1998*), neurotoxin (*Afifiyan et al., 1999*) and phospholipases (*Jeyaseelan et al., 2000*) that responsible for inducing these changes (*Abdel Ghani et al., 2010*).

On the other hand, the present findings show that the restoration of the characteristic myocardium appearance, also showing no histopathological changes, but in some areas, few inflammatory cells between cardiac myocytes were apparently seen in case of injection with γ - irradiated (1.5KGy) venom in a dose equal ½ LD₅₀ (1.67 mg/kg i.p) after 24 hours. Treatment of the venom by gamma radiation in a dose (1.5KGy) markedly reduced the degree of damage induced by the venom in the heart

which appeared more or less normal except for minor abnormalities that were still present.

Similar results were recorded by *Tu & Homma (1970)*; *Rahmy et al., (1995) & Hanafy et al., (1999)*.The haemorrhage observed inbetween the cardiac muscles of animals receiving the venom may be due to increased intravascular tension or venous congestion (*Willoughly, 1960*). In addition, *Rahmy et al., (1991)* reported that the crude venom of *Cerastes cerastes* induced severe haemorrhage as well as extensive myofilament damage at the electron microscopic level.

According to *Shaaban & Hafez (2003)*, it was shown that the injection of *Naja haje* venom in a sublethal dose (0.2 mg/kg) produced severe degeneration of muscle fibers and loss of striations. Also, haemorrhage and extravasated red blood cells were seen inbetween the myocardial bundles.

In addition, *Abib & Laraba-Djebari (2003)* indicated that histopathologic evaluation of heart showed that native *Cerastes cerastes* venom caused severe degenerative changes in the myocardium. In the case of 2KGy irradiated venom, no tissue alterations were observed.

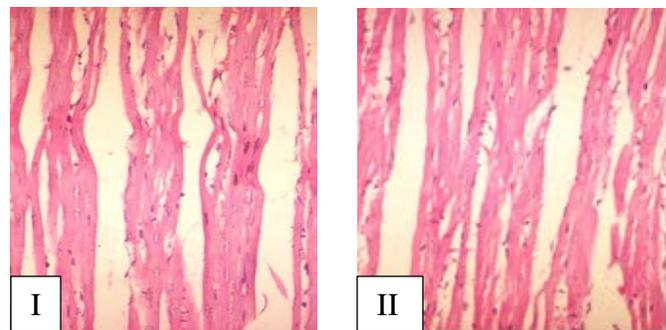


Fig. I &II: Longitudinal section of the myocardium of untreated control rat (H & E; X400).

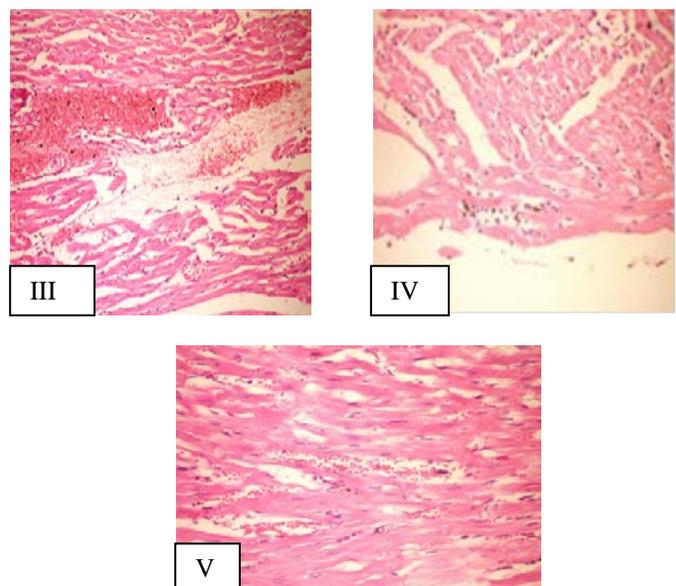


Fig.III: Section in the heart of a rat injected with native venom (0.154 mg /kg i.p.) showing intramuscular oedema and haemorrhage (H&E; X400).

Fig.IV: Section in the heart of a rat injected with native venom (0.154 mg /kg i.p.) showing degenerated muscle fibers with loss of striations (H&E ; X400).

Fig.V: Another section of the myocardium of a rat injected with native venom (0.154 mg /kg i.p.) showing extensive congestion of myocardial blood vessels (H & E; X 400).

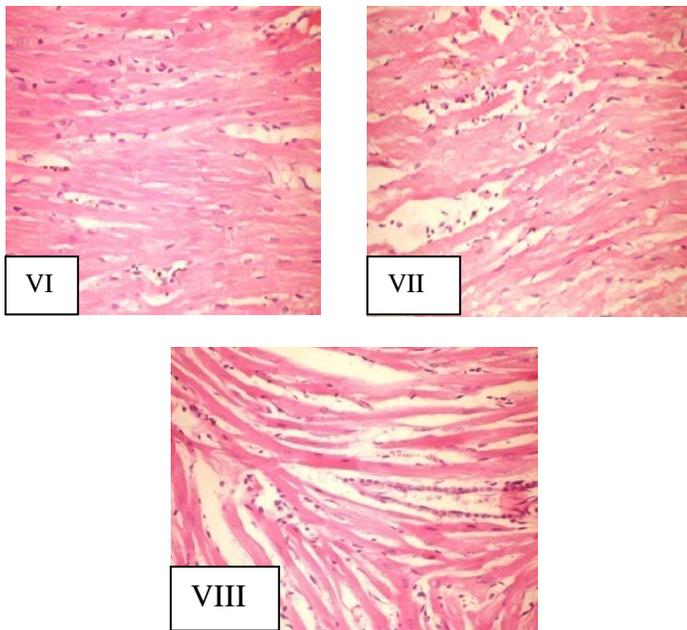


Fig.VI: Heart section of a rat injected with γ -irradiated (1.5KGy) (1.67 mg/kg i.p.) venom showing obvious return to normal myocardial appearance (H & E; X 400).

Fig. VII: Section in the heart of a rat injected with γ -irradiated (1.5KGy) (1.67 mg/kg i.p.) venom showing restoration of the characteristic appearance of cardiac muscle with few inflammatory cells inbetween the myocardial bundles (H & E ; X 400).

Fig. VIII: Another heart section of a rat injected with γ -irradiated (1.5KGy) (1.67 mg/kg i.p.) venom showing restoration of the characteristic appearance of cardiac muscle with minimal extravasation of blood cells inbetween the myocardial bundles (H & E; X 400).

IV. CONCLUSION

Collectively, the present data support the conclusion that gamma radiation is an effective venom detoxification method. Thus, the present data support that, gamma irradiation of *Naja nigricollis* snake venom with 1.5KGy dose offer an effective method for reducing the chronic toxic effect of venom in immunized animals for preparing the best toxoids and vaccines.

REFERENCES

- [1] Abdel Ghani LM, El-Asmer MF, Abbas OA and Rahmy TR, (2010): Cardiotoxic Effects of the Venom of the Black-Neck Spitting Cobra, *Naja nigricollis* Snake. *Egypt J. Natural Toxins*, 7(1, 2): 1-28.
- [2] Abib H and Laraba-Djebari F, (2003): Effects of ^{60}Co gamma radiation on toxicity and hemorrhagic, myonecrotic, and edema-forming activities of *Cerastes cerastes* venom. *Canadian Journal of Physiology and Pharmacology*, 81(12): 1125-1130.
- [3] Afifiyan F, Tan CH, Gopalakrishnakone P and Jeyaseelan K, (1999): Postsynaptic alpha-neurotoxin gene of the spitting cobra, *Naja naja sputatrix*: structure, organization, and phylogenetic analysis. *Genome Res.*, 9: 259-266.
- [4] Aguiyi JC, Guerranti R, Pagani R and Marinello E, (2001): Blood chemistry of rats pretreated with *Mucuna pruriens* seed aqueous extract Mp 101 UJ after *Echis carinatus* venom challenge. *Phytotherapy Res.*, vol.15 (8): 712-714.
- [5] Al-Sadoon MK, Abdel Moneim AE, Diab MS and Bauomy AA, (2013): Hepatic and renal tissue damages induced by *Cerastes cerastes gasperetti* crude venom. *Life Science Journal*, 10(4).
- [6] Antoni F, (1973): The effect of ionizing radiation on some molecules of biological importance. In: *Manual on Radiation Sterilization of Medical and Biological Materials*. Tech. Rep. Series, No 149, PP.13-21.
- [7] Badr G, Al-Sadoon MK, El-Toni AM and Daghestani M, (2012): *Walterinnesia aegyptia* venom combined with silica nanoparticles enhances the functioning of normal lymphocytes through PI3K/AKT, NF κ B and ERK signalling. *Lipids Health Dis.*, 11: 27-27.
- [8] Bancroft JD and Stevens A, (1996): *Theory and practice of histological technique*, (fourth ed.) Churchill, Livingston, Edinburgh, London, Melbourne and New York pp. 50–56.
- [9] Bennacef-Heffar N and Laraba-Djebari F, (2003): Evaluation of the effect of gamma rays on the venom of *Vipera lebetina* by biochemical study. *Canadian Journal of Physiology and Pharmacology*, 81(12): 1110-1117.
- [10] Bhagwat K and Amar L, (2013): Blood Hemoglobin, lactate dehydrogenase and total creatine kinase combinely as markers of hemolysis and rhabdomyolysis associated with snake bite. *International Journal of Toxicological and Pharmacological Research*, 5(1): 5-8.
- [11] Boni-Mitake M, Costa H, Spencer PJ, Vassiliev VS and Rogero JR, (2001): Effects of ^{60}Co gamma radiation on crotamine. *Braz. J. Med. Biol. Res.*, Volume 34(12), p.1531-1538.
- [12] Chippaux JP, (1998): Snake-bites: appraisal of the global situation. *Bull World Health Organ*, 76, 515–524.
- [13] Clissa PB, Nascimento N and Rogero JR, (1999): Toxicity and immunogenicity of *Crotalus durissus terrificus* venom treated with different doses of gamma rays. *Toxicon*, 37:1131-1141.
- [14] Fernando C, Jose MG, Bruno L and Luis C (1989): Histopathological and biochemical alterations induced by intramuscular injection of *Bothrops Asper* venom in mice. *Toxicon*, 27 (10):1085-1093.
- [15] Finney D J, (1964): *In statistical Method in biological assay*, Charles Griffen and Company Limited, London, 528.
- [16] Gaballa M, Taher T, Brodin LA, van der Linden J, O'Reilly K, Hui W, Brass N, Cheung PK and Grip L, (2005): Myocardial infarction as a rare consequence of a snakebite: diagnosis with novel echocardiographic tissue Doppler techniques. *Circulation*, 112 (11):140-142.
- [17] Gutierrez JM, Theakston RD and Warrell DA, (2006): Confronting the neglected problem of snakebite envenoming: the need for a global partnership. *Plos-Medicine*, 3(6):727-731.

- [18] Hanafy MS, Rahmy NA and Abd El-Khalek M M, (1999): The dielectric properties of neutron irradiated snake venom and its pathological impact. *Med. Biol.*, 44: 2343-2364.
- [19] Hayes AW and Francis T, (2001): Principle and methods of toxicological fourth edition edited by Wallace Hayes, Taylor and Francis, 1039 - 1084.
- [20] International Federation of Clinical Chemistry (IFCC) (1989): Methods for the measurement of catalytic concentration of enzymes, Part 7: IFCC method for creatine kinase, *JIFCC*; 1: 130 - 139.
- [21] Jessica M, Baptista JA, Caproni P, Yoshito D and Nascimento N, (2009): Evaluation of mitotoxic activity of bothropstoxin-1 irradiated with ⁶⁰Co gamma rays. International Nuclear Atlantic Conference - INAC, Rio de Janeiro, RJ, Brazil: 978-85.
- [22] Jeyaseelan K, Armugam A, Lachumanan R, Tan CH and Tan NH, (1998): Six isoforms of cardiotoxin in Malayan spitting cobra (*Naja naja sputatrix*) venom: cloning and characterization of cDNAs. *Biochim. Biophys. Acta*, 1380 (2): 209-222.
- [23] Jeyaseelan K, Armugam A, Donghui M and Tan N, (2000): Structure and Phylogeny of the Venom Group I Phospholipase A₂ Gene. *Mol. Biol. Evol.*, 17: 1010-1021.
- [24] Kasturiratne A, Wickremasinghe AR, de Silva N, Gunawardena NK and Pathmeswaran A, (2008): The global burden of snakebite: a literature analysis and modelling based on regional estimates of envenoming and deaths. *PLoS Med.*, 5(11), 218.
- [25] Lucas de Oliveira PC, Sakate M, Madruga RA and Barbosa NPU, (2007): Biochemical and hematological study of goats envenomed with natural and ⁶⁰Co-irradiated bothropic venom. *J. Venom. Anim. Toxins incl. Trop. Dis.*, vol.13 no.3 p. 577.
- [26] Mady EA, (2002): Antitumor and biochemical effects of *Echis coloratus* crude venom on Ehrlich ascites carcinoma cells in vivo. *J. Venom. Anim. Toxins* 8: 283-296.
- [27] Maheshwari M and Mittal SR, (2004): Acute myocardial infarction complicating snake bite. *J. Assoc. Physicians India*, 52: 63-64.
- [28] Meenatchisundaram S and Michael A, (2010): Snake bite and therapeutic measures: Indian Scenario, *Indian Journal of Science and Technology*, 2(10), pp 69-73.
- [29] Murata Y, Nishikawa AK, Nascimento N, Higashi HG, Dias Da Silva W and Roger JR, (1990): Gamma radiation reduces the toxic activities of *Crotalus durissus terrificus* venom but does not affect their immunogenic activities. *Toxicon*, 28:617.
- [30] Nascimento N, Spencer PJ, Andrade HF, Guarnieri MC and Rogero JR, (1998): Effects of gamma radiation on snake venoms. Volume 52, Issues 1–6, Pages 665–669.
- [31] Ouchterlony O, (1948): In vitro method for testing the toxin-producing capacity of diphtheria bacteria. *Acta pathologica et microbiologica Scandinavica* 25 (1-2):186 -191.
- [32] Oussedik-Oumehdi H and Laraba- Djebbari F, (2008): Irradiated Cerastes cerastes venom as a novel tool for immunotherapy. *Immunopharmacol Immunotoxicol*, 30: 37-52.
- [33] Paget GE and Barnes JM, (1964): Evaluation of drug activities, In: Laurence DR, Bacharach AL (ed.) *Pharmacometrics* Vol. 1, p 161. London: Academic Press.
- [34] Rahmy TR, Tu AT, El-Banhawy MA, El-Asmar MF and Hassan FM, (1991): Electron microscopic study of the effect of Egyptian sand viper (*Cerastes cerastes*) venom and its hemorrhagic toxin on muscle. *J. of Wilderness Medicine*, 2:7-14.
- [35] Rahmy TR, Ramadan RA, Farid TM and EL-Asmar MF, (1995): Renal lesions induced by cobra envenomation. *Journal of Egyptian German Society of Zoology*, 17(C) 251-271.
- [36] Reitman S and Franked S, (1957): A Colorimetric method for the determination of transaminases. *Clin. Anal. Am. J. Clin. Path.*, 28: 56-63.
- [37] Saadeh AM, (2001): Acute myocardial infarction complicating a Viper bites. *Am. J. Trop. Med. Hyg.*, 64(5, 6): 280-282.
- [38] Saleh MA, (1997): Amphibians and reptiles of Egypt. National biodiversity unit publications 6, Cairo, Egypt.
- [39] Shaaban EA, (1990): Studies on impact of irradiation treatment on pharmacological responses of scorpion venom and antivenin serum. Ph. D. Thesis, Faculty of Pharmacy, Alexandria University.
- [40] Shaaban EA, Ahmed AA and Ayobe M, (1996): Gamma irradiation of Egyptian Cobra (*Naja haje*) Venom. *J. Egypt Public Health Assoc.*, 71:257-267,269-271.
- [41] Shaaban EA, (2003): Influence of ionizing radiation on cobra venom (*Naja haje*) and cerastes cerastes venoms: Toxicological and Immunological aspect. *The Egyptian Journal of Hospital Medicine*, 13: 99 - 111.
- [42] Shaaban EA and Hafez MN, (2003): Ability of gamma-irradiated polyvalent antivenin to neutralize the toxicity of the Egyptian Cobra (*Naja haje*) venom. *The Egyptian Journal of Hospital Medicine*, 13: 135 - 152.
- [43] Shaaban EA, El-Missiry AG, Mohamed RM, Ahmed AA, Abdallah, NM and Moustafa MI, (2010): Influence of ionizing radiation on *Echis pyramidius* snake venom: biochemical and immunological aspects. *Egypt. J. Hosp. Med.*, 40: 314-334.
- [44] Souza FA, Spencer PJ, Rogero JR, Nascimento N, Dal Pai-Silva M and Gallacci M, (2002): ⁶⁰Co gamma irradiation prevents *Bothrops jararacussu* venom neurotoxicity and myotoxicity in isolated mouse neuromuscular junction. *Toxicon*, 40: 1101-1106.
- [45] Szasz G, Gruber W and Berndt E, (1976): Creatine kinase in serum. *Clin. Chem.*, 22:650-656.
- [46] Theakston RD, Warrell DA and Griffiths E, (2003): A report of a WHO work shop on the standardization and control of antivenoms, *Toxicon*, 41, 541–557.
- [47] Tresseler KM, (1988): Clinical laboratory and diagnostic tests 2nd ed., pp., 116-130. Englewood Cliffs, NJ: Prentice-Hall.
- [48] Tu AT and Homma M, (1970): Toxicologic study of snake venom from Costa Rica. *Toxicol. Appl. Pharmacol.*, 16:73-78.
- [49] Wacker WEC, Ulmer DO and Vallee BL, (1956): Lactate dehydrogenase in human serum. *New Eng. J. Med.*, 225:449-451.
- [50] Warrell DA, (1993): Venomous bites and stings in the tropical world. *Med. J. Aust.*, 159, 773-779.
- [51] World Health Organization, (1981): Progress in the characterization of venom; and standardization of antivenoms. Geneva: World Health Organization. Off set, pp. 23-24.
- [52] Willoughly DA, (1960): Pharmacological aspects of the vascular permeability changes in the rat's intestine following abdominal radiation. *Br. J. Radiol.*, 33: 515-519.

AUTHORS

FATMA Y. ABDOU – PHARMACIST IN DRUG RADIATION RESEARCH DEPARTMENT – NATIONAL CENTER FOR RADIATION RESEARCH AND TECHNOLOGY – ATOMIC ENERGY AUTHORITY, EGYPT. FATMAYEHIAA2007@YAHOO.COM

EZZ EL DIN EL DENSHARY – PROFESSOR OF PHARMACOLOGY & TOXICOLOGY FACULTY OF PHARMACY – CAIRO UNIVERSITY. DENSHARY@GMAIL.COM

ESMAT A. SHAABAN – PROFESSOR OF PHARMACOLOGY & TOXICOLOGY – NATIONAL CENTER FOR RADIATION RESEARCH AND TECHNOLOGY – ATOMIC ENERGY AUTHORITY, EGYPT. ESMAT_SHAABAN@YAHOO.COM

MARWA A. MOHAMED – LECTURER IN DRUG RADIATION RESEARCH DEPARTMENT – NATIONAL CENTER FOR RADIATION RESEARCH AND TECHNOLOGY – ATOMIC ENERGY AUTHORITY, EGYPT. MARWABIOCHEMISTRY@YAHOO.COM

CORRESPONDENCE AUTHOR – FATMA Y. ABDOU, FATMAYEHIAA2007@YAHOO.COM, +201001870617

Collaboration Strategy in the Cross-Border Utilization of the springs of Senjoyo in the Border Area of the City of Salatiga and the Regency of Semarang, Indonesia

Hadi Wahyono*, Achmad Djunaedi**, Bakti Setiawan***, Leksono Subanu****

*) Department of Urban and Regional Planning, Diponegoro University, Indonesia.

**) Department of Architecture, Gajah Mada University, Indonesia.

***) Department of Architecture, Gajah Mada University, Indonesia.

****) Department of Architecture, Gajah Mada University, Indonesia.

Abstract- In Indonesia, the inter-regions cooperation between the adjacent regions of the cross-border government services, have to be formally performed if the services have cross-regions externalities; and the provision of the services will more efficient if managed together. Therefore, the cooperation utilization of the Springs of Senjoyo between the Regency of Semarang and the City of Salatiga, which has a cross-regions externalities, have to be performed in formal cooperation. However, as there is not any cooperation agreement between, the cooperation is only based on a tradition which is done for a long time ago. The purpose of the research discussed in this article is to examine how inter-regional collaboration strategies are used in the interaction of the parties involved in the management of water utilization of the Springs of Senjoyo, and what matters that influence it. The research used the grounded theory research method, in particular Straussian mainstream, as the method is suitable for the intends of the research. Based on the research findings, it can be concluded that the City Government of Salatiga uses functional assertive collaboration strategies in the region interaction, because utilizing resources from neighboring areas, to meet the water needs of the population in the region. Meanwhile, the Regency Government of Semarang uses a strategy of cooperative collaboration between functional areas, because the government gives permissions to neighboring areas to take advantage of the resources available in the region. The strategy is a proper solution to solve the problem that the interaction is not a formal cooperation agreement. Both the interaction regions for the interaction of long-standing and become a tradition.

Index Terms- collaboration strategy, collaborative planning, border area, cross-border public service

I. INTRODUCTION

Having an area only 56.781 km², the City of Salatiga is the second smallest regions in the Central Java Province, after the City of Magelang which is the first as it only has an area of 18.12 km². Because it is located in the central part of the Regency of Semarang, the entire border area of the city is directly adjacent to the regency. This indicates that the development of the city is strongly influenced by its neighbor. One of the influences is the provision of some natural resources by the regency, which cannot be provided by the city. Among them is the water resource.

Because it has only a small territory, the City of Salatiga has limitations in natural resources, including water resources. To meet the increasing clean water needs, which follow the increasing number of people of the city, the Drinking Water Company (PDAM-Perusahaan Daerah Air Minum) of the city utilizes water resources originating not only from within the city own territory, but also from its neighbor. The water resources within the city region are surface spring waters, which are the Springs of Kalisambo, Kaligetak, Kalitaman, Kaliputri, Kaligedangan and Kalibenoyo. The springs are part of the slope of the Mount of Merbabu. However, their available capacities are relatively small, which is between 30 to 120 liters/Sec. The available discharge of the springs is insufficient to meet the needs of the population of the city.

Therefore, besides utilizing their own resources, the PDAM also utilizes the resources of the neighboring region, that is the Regency of Semarang. The springs of the regency, which are utilized, are the Springs of Senjoyo and Kaligojek. Compared with other springs, the Springs of Senjoyo, which also often called Umbul Senjoyo, has the largest available capacity, which is about 1,655 liters/Sec. While, the Springs of Kaligojek has only a capacity of about 30 liters/Sec.

Because of its large discharge capacity, the Springs of Senjoyo is utilized not only by the PDAM of Salatiga City, but also by some other parties. Among them is, certainly, the PDAM of Semarang Regency, which usage the water from the springs for serving the villages surrounding the springs. The other party is the people from surrounding the springs that usage the water for a variety of everyday purposes, such as washing, cooking and bathing. Besides, for the farmers, the water is utilized for irrigation in their paddy fields. Meanwhile, for a textile company, PT. Damatex, the water is utilized as industrial raw water for their production processes. The other beneficiary is the military barracks of Infantry Battalion 411 Salatiga, which use the water for its dormitories.

Besides, because of having several tourist attractions, the area surrounding the Springs of Senjoyo has been developed as a tourist destination by the Regency Government of Semarang. Some of the major available tourist attractions are the beautiful scenery, the area surrounding the Lake of Senjoyo which can be used for camping ground, and the lake which can be used for bathing and practicing the kungkum (soaking) ritual. The kungkum ritual is a ritual performed by someone by soaking in the lake, in order to ask something to the God, as they believe that the water of the springs contains certain magical properties. They just emulate the ritual of Joko Tingkir, the historical figure having supernatural powers, to obtain the powers by performing the kungkum in the lake.

Unfortunately, the utilization of the Senjoyo Area is not optimally managed, as the increasing various activities exploiting the area led to a variety of environmental problems. Among them are the accumulation of garbage and the decreasing forest area surrounding the springs. The destruction of the forest has led to diminishing of the water catchment area of the springs. Consequently, the environmental damages can reduce the supply of natural water to the springs. As a result, the discharge capacity of the springs have reduced.

The utilization of the Springs of Senjoyo is chosen to be studied, because it involves various parties with different purposes and backgrounds. As the formal authority of the Senjoyo area, the Regency Government of Semarang seeks to manage all parties involved in the usage of the springs. The management needs to be given that the springs needs to be protected so that there is a sustainable source of water. One of the efforts is set in the area around the spring has been a conservation area.

According to the Law No. 23/2014 on the Local Governance, the cooperation between neighboring regions are mandatory. The cooperation shall be developed jointly between the adjacent areas for the implementation of government affairs which have cross-regions externalities; and the provision of public services will more efficient if managed together. Under the provisions of these regulations, the use of water from the Springs of Senjoyo by the City of Salatiga included in the delivery of government affairs which has a cross-regions externalities. Therefore, the implementation must be undertaken in the form of inter-regions cooperation.

In fact, not all parties involved in the usage of the water of the Springs of Senjoyo possess a clear formal cooperation. The cooperation which has been guided by a formal cooperation is the cooperation between the PDAM of Semarang Regency and the textile company, PT. Damatex in 1975. The cooperation includes the agreement of the fee compensation, which have been paid by the company. The fee compensation had been paid, but then stopped, because the money has not been used in accordance with the objective being to the maintenance environment around the springs.

This illustrates that although it has been expressed through legislation that the interaction between regions that are externalities is an obligation, actually, it cannot be undertaken easily in the border area of regions. This is caused by the difficulty to bring direct inter-regions autonomy interaction in the region. Given that the interaction between the regions is a collaborative planning process, it is necessary the explanations of inter-regions collaboration strategies used in the interactions.

Based on the background of the problems explained above, the research discussed in this article has the following research questions: How inter-regional collaboration strategies used in the interaction of the parties involved in the management of water utilization of the Springs of Senjoyo, and why? Based on the research question, the purpose of the research discussed in this article can be formulated that is to examine how inter-regional collaboration strategies are used in the interaction of the parties involved in the management of water utilization of the Springs of Senjoyo, and what matters that influence it.

II. INTER-REGIONS COLLABORATION STRATEGIES

Inter-regions planning, particularly that occurs in the interaction between regions in urban areas in the border cities in Indonesia, aims to develop inter-regions collaboration. This approach is needed to develop the synergies of the potentials of the regions, that can be used for the development of the border area together. To achieve the objective, the process of planning needs to be based on the collaborative planning approach. The collaborative planning approach is a practical approach to communicative planning theory, which emphasizes the building process of agreement or understanding between the involved parties involved (O'Leary and Vij, 2012; O'Flynn and Wanna, 2008; Healey, 2006).

Gray (1989) stated that collaborative action is the process of interaction between the parties who see a problem from different sides, explore the differences between them, and find solutions together through of the agreement. The solution is a joint opinion adopted by all parties involved in the planning as discussed and negotiated. The development of the solution becomes the focus in collaborative planning process for not only to share information, but also to create an innovative and creative action to develop the solution together. The solution is not only built through sharing of information, but also a variety of ideas, thoughts, potentials, power authorities, and political power.

Recently, planners have used the collaborative planning for involving parties, such as the government, private and public, in accommodating the interests of the public (Healey, 2006; Margerum, 2002). In the metropolitan region, especially in inter-regions cooperation in urban areas, the planners use the planning on the interaction between the regions for building the cooperation between regions (McCarthy, 2007). Because the interactions between regions are varied, the planning also has various kinds of characteristics of with different collaborative natures. In order for the right kind of action, planners using the collaborative strategies to determine the type of collaborative action.

Undertaking the collaborative planning approach requires collaboration strategies. In this research, the definition of the inter-regions collaboration strategy is the collaborations between the regions to build solutions to overcome the problems in urban areas in the city border. The strategy is the general direction to take an action. Therefore, the strategies need more various operational directions, that are action plans and execution managements. An action plan is operational directives will be implemented. While the execution management is needed to direct the implementation.

Based on Healey (1991), the inter-regions strategic collaboration in the border area of the city, can be grouped into five styles of action planning, namely: 1) the social reform planning style, which is planning oriented to meeting the needs and interests of the community, as part of social reform process in a particular region; 2) the policy analysis planning style, namely planning oriented planners oriented expertise as a policy analyst; 3) the managerial planning style, including planning which intends to manage the fulfillment of the needs and interests of the community, both in the region itself and its neighbors; 4) the intermediation planning style, including planning oriented to the tasks of government, who regard the city as its own regional interaction with its neighbors; and 5) the bureaucratic planning style, the planning is oriented to the tasks of government to meet the needs and interests of their own city or region. In short, the strategy of inter-regions collaboration is a collaborative action plan utilized by planners to build a joint of agreement, through the bureaucratic approach, intermediation, social reform, or managerial and policy analysis styles.

Based on Thomas (1976, 1992), the management styles of interaction has two strategies namely: 1) the assertive management, which focuses only to promote their own interests; and 2) the cooperative management, which is more concerned with the interests of other parties. Based on the concept of Thomas (1976, 1992), then the types of inter-regions collaboration strategies can be as follows: 1) the avoiding management style, which sees the existence of the border area is not important; 2) the competition management style, which exploits the potential of the border area for the benefit of their own region; 3) the accommodation management style, namely the desire to accommodate the management of its neighbors to jointly exploit the border area; 4) the collaborative management style, the building management and the neighboring city of agreement to establish joint border area; and 5) the compromise management style, that put forward a compromise between the city and its neighboring blood in the development of border areas. In short, from the view of management styles, the collaboration strategy consists of assertive management that emphasizes its own country, consisting of the avoiding management style and competition management style; the cooperative management, consisting of management style accommodation and collaborative management style; as well as the management style compromise.

Besides the collaborative planning, the inter-regions collaboration strategy also requires management mediation. Mediation is a process of engaging a third party, called a mediator in an interaction (Horowitz, 2007). In the border areas of the city, the mediator bridging the interaction between the city and its neighbors. According Riskin (1996) style of mediation consists of two types, namely facilitative and evaluative mediation. Facilitative mediation is a mediation that provide an atmosphere conducive to helping the parties to beinteraksi build consensus. In this mediation, planners act as intermediaries that bridges the interaction in the process of planning (Healey, 1991). While evaluative mediation is mediation that mimics the trial in court. Mediator is like the judge who issued decisions that must be made by the parties to the dispute. In this case, the planner uses his expertise to evaluate the conflict, and provide solutions to resolve the conflict.

III. OVERVIEW OF THE SPRINGS OF SENJOYO UTILIZATION

The Springs of Senjoyo is located approximately 2 km from the main arterial road of Semarang-Solo in eastward. Administratively, the Springs of Senjoyo is located in the authority area of the Villages of Tegalwaton and Bener, the District of Tengaran, the Regency of Semarang. The springs are right in the middle of the area that divides the two villages, and into the separator between them. The border area of the Senjoyo area is located in the north of the Village of Bener, the east of the Village of Tegalwaton, the west of the Village of Bener and the south of the Village of Tegalwaton. The Village of Tegalwaton is directly adjacent to the the Village of Tingkir Tengah, the District of Argomulyo, the City of Salatiga.

The Springs of Senjoyo is located on the slopes of Mount Merbabu, with a height of approximately 608 m above sea level. The springs is located in the hills of the valley between two hills that flank the west and east side. Hill in the west has a height of approximately 670.5 m dpal. While the hill to the east has a height of 706 m dpal. The hills are filled with large and old trees in the area surrounding the springs, used as a camping ground.

The Springs of Senjoyo has a large water discharge. In the year of 2006, its discharge was recorded at 1156.00 m³/sec. However, In 2011, the discharge has decreased relatively sharp, at 1,023 m³/sec, due to the conversion of agricultural land and forests in its surrounding area into residential areas. The large discharge of the springs are utilized as water sources for the irrigation of agricultural land in the surrounding area, and also utilized by various parties. The PDAM of Salatiga utilizes the water of springs approximately 190 liters/second as a source of clean water for the city and its neighboring region. Meanwhile the PDAM of the Regency of Semarang take about 30 liters/sec to be distributed to villages around Salatiga. Water of the springs is also utilized as the industrial raw water, that taken by the textile company, PT. Damatex, of approximately 53 liters/sec. It is also utilized by the Infantry Battalion of 411 of Salatiga, took about 11.8 liters/sec for the needs of their dormitories. The rest is taken directly by the surrounding villages for irrigation, bathing and washing, and partly taken by the Village of Karang Gondang, the Distric of Pabelan, the Regency of Semarang.

Actually, the joint utilization of the water of the Springs of Senjoyo has occurred since the President Soekarno era. The joint usage of the springs was established between the Regency Government of Semarang with the textile company, PT. Damatex, since the company's founding in 1961. For the usage, PT. Damatex have to pay compensation for environmental conservation Rp. 7.500.000, - for a period of 4 years starting in 2005 and payment for water usage with the calculation of Rp. 500,-/m³. However, conditions on the ground that the compensation fee had not even realized by the Regency Government of Semarang for environmental conservation in the Senjoyo area. It reflects the government's indifference to manage the Senjoyo area, besides a lack of coordination between the fields that deal with water use areas that deal with environmental problems.

Another partnership that is being sought is the cooperation between the Regency Government of Semarang with the City Government of Salatiga. This cooperation scheme to some joint decision between the PDAM of Salatiga City and the PDAM of Semarang Regency not between the regions that have the force of law. In this cooperation, the the PDAM of Salatiga pay certain royalties based on the amount of water flow taken to the PDAM of Semarang Regency. However, until now, this cooperation progress is still in a discussion, so that there is not any final agreement. Utilization the springs by the PDAM of the Regency of Semarang as raw water is utilized to serve the the Tingkir area which are parts of the City of Salatiga and Tegalwaton village which is part of The Regency of Semarang. While the use of water by the PDAM of Salatiga City for raw water utilized to serve most areas of Salatiga and parts of The Regency of Semarang. Exchange of services based on the proximity of the service area in order to improve the raw water distribution operations.

Utilization of water sources for the raw water needs more enjoyed by the City of Salatiga. This was due to the geographical location of the city that is lower than the Springs of Senjoyo. Thus, the springs is a strong supporter in the development of the City of Salatiga through providing clean water infrastructure. In the direction of spatial planning, the provision of raw water in the development of any industrial area, in particular in the District of Tengaran, is not allowed to take from the direct ground water, but they have to use the water from the Lake of Rawapening and the Springs of Senjoyo through the taps networking of PDAM. The ground water drilling is feared could lead to a decrease in water discharge of the springs in this region.

The Regency of Semarang Regulation Number 6/2011 on the Regional Spatial Plan of Semarang Regency Year 2011-2031, directed that the Senjoyo Area has been designated as a conservation area, and the forest surrounding the springs has been protected as the water catchment area for the springs. Thus functioned as Senjoyo Region there are several springs that have a large enough flow so as to supply the water needs of the surrounding area. To protect the Senjoyo area, the spatial regulation directs the need for protection of the existing dam and reservoir construction of the Village of Lebak, the District of Bringin.

Meanwhile, according to the City of Salatiga Regulation Number 4/2011 on the City of Salatiga Spatial Plan Year 2010-2030, the Springs of Senjoyo area is directed as a source of raw water to meet the needs of the PDAM of the city. The Springs of Senjoyo geared to serve the Villages of Tingkir Lor, Tingkir Tengah, Ledok, Tegalrejo, Mangunsari, Kalicacing, Kecandran, Sidorejo Lor, and Pulutan Mangunsari. The policy shows that although the springs is located and formerly owned by the Regency of Semarang, but has become one of the important resources of raw water for the PDAM of the City of Salatiga.

Moreover, the Regency of Semarang Spatial Plan Year 2011-2031 directs the Springs of Senjoyo Area as a tourist area. Aside from being a protected area, the Senjoyo area also is a place for recreation and perform kungkum (soaking) rituals of certain people who visit the area because of their religious beliefs. In the Regency of Semarang Tourism Master Plan, the territory of the regency is divided into four Tourism Development Regions (WPP-Wilayah Pembangunan Pariwisata) and ten Tourism Development Area (KPP-Kawasan Pengembangan Pariwisata). The Senjoyo area is included in the WPP-4 and KPP-1. The KPP-1 includes the Districts of Tengaran, Suruh, Susukan and Kaliwungu with the service centers in the District of Tengaran. The focussed attractions of the KPP-1 is the Senjoyo area with its water springs, natural attractions, and cultural folk art.

The Senjoyo area is developed to become a tourist attraction based their visit people who believe in the mystical value of springs Senjoyo. They visited on certain nights like Tuesday and Friday night kliwon, 1 Shura night, the night of 15 in the Javanese calendar and visit occurred on the night to 21 Ramadan. They visited to perform rituals in the the Springs of Senjoyo kungkum this in order to obtain a blessing and welcome the arrival of the Lailatul Qodar. The soaking ritual in the Springs of Senjoyo, called as kungkum is in order to seek blessings by giving offerings at Joko Tingkir ruins located near the ponds ritual.

IV. RESEARCH FINDINGS AND DISCUSSIONS

There are some different parties involved in the interaction between regions that occur in the cross-border utilization of the Springs of Senjoyo in urban areas on the border of the City of Salatiga. The water of the Springs of Senjoyo is utilized as raw water by different parties, which are the PDAM of the Regency of Semarang to serve the Village of Tegalwaton of the District of Tengaran and the Villave of Tingkir Tengah of the City of Salatiga. While the PDAM of Salatiga utilizes the raw water to serve most parts of the south of the city, and the District of Tuntang of the Regency of Semarang. While the textile industry, PT. Damatex utilizes the raw water for industrial purposes. Meanwhile, the Infantry Battalion 411 Salatiga utilizes the raw water to meet the needs of their soldier housing and other military activities.

As an irrigation water along the River of Senjoyo, the water from the Springs of Senjoyo is utilized to flood the rice fields in the Villages of Bener and Tegalwaton, the District of Tengaran and most of the flow through the rice fields in the Districts of Suruh, Pabelan, Bringin and Bancak, of the Regency Semarang as well as a small part of Salatiga region. Besides, the people of the surrounding villages utilized the water for washing, bathing and other activities. Some persons use the springs for recreational activities, such as camping, playing games and enjoying the beautiful panorama surrounding the springs. Some persons undertake kungkum (soaking) ritual at a certain time. As it has been explained before, the kungkum ritual is a ritual which some person soaks in the lake of the Senjoyo in order to ask something to the God, as they believe that the water of the springs contains certain magical properties. They just emulate the ritual of Joko Tingkir, the historical figure having supernatural powers, to obtain the powers by doing the kungkum in the lake.

However, as the Springs of Senjoyo is on the authority area of the Regency of Semarang, all activities must obtain permissions from the authority. In other word, the utilizations should be based on the consent of the Regency Government of Semarang. This is necessary because local governments have a responsibility to maintain the sustainability of the use of the springs. The formal cooperation that has been done, is with PT. Damatex, which has been done since 1975. However, the legal cooperation between the

Regency government of Semarang with the City of Salatiga or the PDAM of Salatiga have not been completed. While the cooperation permit with the 411 Infantry Battalion Complex Salatiga has not been initiated at all.

Borrowing a term of Selden, Sowa, and Sandfort (2002), the interaction that occurs in this object research is the cooperative interaction, because the Regency Government of Semarang allows the parties who use water the Springs of Senjoyo, including from neighboring towns. Meanwhile, the use of cross-border raw water occurs has not been guided by a clear cooperation agreement for all parties. Utilization the Springs of Senjoyo itself together is a tradition that lasted a long time (since 1960). Policies allow various parties to utilize the Springs of Senjoyo is a form of respect for the tradition.

In the interaction between the regions of the research object, the City of Salatiga considers that its border area has potentials in the form of the large discharge of the Springs of Senjoyo to meet the needs of the raw water of its PDAM. Borrowing a term of Blatter (2006), the City of Salatiga considers the border area as the frontier area, for being able to be utilized for the development of the city. Meanwhile, the Regency Government of Semarang that allows potential Springs Senjoyo utilized by the PDAM of Salatiga considers the border area as a backyard, because it allows the natural resources is utilized by its neighbors.

The attitude of the City Government of Salatiga in general and the PDAM of Salatiga in particular the view that the neighboring areas have the potential to supply raw water for water supply, so it needs to be utilized, showing their attitude, to borrow a phrase Thomas (1976, 1992), is assertive strategy. The assertive strategy is the strategy that leads directly to the destination, honest, open, confident, and resolute stance. Thus, the city has high confidence to get approval in the use of natural resources that are in the neighboring regions, in particular the use of the Springs of Senjoyo in Regency of Semarang.

Meanwhile, the Regency Government of Semarang considers that the Springs of Senjoyo is a natural resource that is needed by some parties, including by the PDAM of Salatiga, so it needs to be managed by cooperative approaches, including taps allow Salatiga come to use it as a source of raw water. In the words of Thomas (1976, 1992), the attitude of the Government of Regency of Semarang was called as cooperative. The cooperative strategy is the strategy that is willing to meet the needs and interests of individuals/ groups. In this research object, the Regency Government of Semarang to cooperate against various parties who utilize the Springs of Senjoyo, including from the PDAM of Salatiga.

When viewed from the utilization planning process, the parties who use the water the Springs of Senjoyo do individually. The planners involved in the interaction are from the PDAM of Salatiga, the PDAM of Semarang, and the Office of Public Works of the Semarang Regency. The results of the planning is done individually coordinated through the regular meetings forum by the PDAM of Semarang and the Office of Public Works of Semarang Regency. The Office of Public Works should have developed and implemented planning, monitoring, control and coordination of the use made by all beneficiaries. However, the agency has not been able to perform its role optimally.

Borrowing a term Healey (1991) that such an attitude planners, including planning policy studies, IE oriented planner to planner expertise as a policy analyst. Utilization plan Springs Senoyo carried along through policy studies PDAM Semarang and Regency of Semarang Department of Public Works. Planning is done for to implement the tradition of cooperation between the parties that use water the Springs of Senjoyo. Planning policies are assessments that bring The Regency Government of Semarang policy with the policy beneficiaries Senjoyo Springs, based on inter-regional policy.

Judging from his management, the substance of the research object management is the management of the utilization of the Springs of Senjoyo as a source of raw water for water services in the border area Salatiga and Regency of Semarang. Interaction between the managed area is the use of shared water the Springs of Senjoyo as raw water. Business activity is in fact composed of several institutions, namely taps Regency of Semarang, Department of Public Works for Water Resources and Energy and Mineral Resources of Semarang Regency and villages that have territory in the Springs of Senjoyo.

For the City of Salatiga, the border area is a frontier area, because it has the potential to support the supply of raw water for the provision of clean water through the PDAM of Salatiga. The Regency of Semarang considers the border area as a backyard area, because it allows neighboring regions to obtain the raw water supply of water resources in the border areas in the region. This can occur due to the inability of the Regency of Semarang in support of its development, particularly in the provision of clean water in their villages in the border area with Salatiga. Besides, the management of such shows appreciation for the tradition of the regency joint use the Springs of Senjoyo.

When viewed from the position of urban management, the interaction found in middle management and management first. Interaction in middle management is the interaction between several regional institutions, which are the PDAM of Salatiga City, the PDAM of Semarang Regency, and the Office of Public Works for Water Resources and Energy and Mineral Resources of Semarang Regency. The nature of the interaction management is technically implementation of the government policies. At the first level of management, the management performed by village governments that manage the Springs of Senjoyo to meet the needs of the people of the villages. In addition, the village governments are firstly role in allowing a variety of users, such as the PDAM of Salatiga and other beneficiaries.

In this research, the PDAM of Semarang Regency and the Office of Public Works for Water Resources and Energy and Mineral Resources of Semarang Regency have roles in planning and control of water supply services across the regions. The Office has specific tasks, that is monitoring the utilization of the Springs of Senjoyo, within the framework of preserving these springs. While the PDAM role is coordinating utilization. Meanwhile, the Tegalwaton Village, Tenganan District, Semarang Regency contributes directly supervise the use by various users, both from the public living surrounding the springs, or by the PDAM of Salatiga and Semarang.

From the analysis of the roles and functions of the parties involved in the interaction between the regions in the Springs of Senjoyo utilization, it can be concluded that such the interaction is cooperative, the interactions made by an area that gives permission to the

neighboring regions to provide cross-border services entry into the border area in the jurisdiction. The permission was given in honor of joint use of water from the Springs of Senjoyo has become tradition, as it has been done for a long time.

According to Thomas (1976, 1992), the cooperative interaction occurs because one of the parties that interact is to accommodate the wishes or authorize others to exploit its potential. In general, this can happen because the party providing the license, in this case the Regency Government of Semarang sees its border area as the backyard because it allows the utilization of its resources, in this case is the Springs of Senjoyo utilized by neighboring regions. In this case, based on the criteria of Thomas (1976, 1992), the Regency of Semarang cooperative towards its neighbors. Meanwhile, for the City of Salatiga, resources the Springs of Senjoyo is a potential that can support the fulfillment of clean water. Thus, the City of Salatiga is assertive in the management of the interaction between these regions.

From the analysis of the management of water supply services cross-border areas, it can be formulated that interaction occurs between regions that are informal coordination interaction. Such interactions are not based on a formal cooperation agreement, but based on the tradition that has been going on for a long ago. Meanwhile, the Regency Government of Semarang, in particular the policy determinants is not actively involved. In other words, the interaction is not based on any formal cooperation among local governments concerned.

Meanwhile, based on the characteristics of urban management, the Regency Government of Semarang use property management, due to accommodate the wishes of the PDAM of Salatiga City to use water from the Springs of Senjoyo as raw water. According to Thomas (1976, 1992), property management is management that allows the involvement of other parties in exploiting the potential contained within his own party. The accommodation management style may occur due to self-consciousness that its potential can also be utilized by others who need it. In this research, because the capacity of the Springs of Senjoyo contained in the border area, the Regency Government of Semarang to allow the PDAM of Salatiga City to use.

In the terms of the characteristics of mediation management, interaction between regions in this research do not involve any third party as a mediator that bridges the interaction. Interaction without mediators also performed during the conflict. The shape of the conflicts that have occurred are between groups of people who use the water for irrigation, because of the presence of groups of people who feel they have an unfair supply. The conflict is resolved through inter-village meetings..

V. CONCLUSIONS

Under the Law No. 23/2014 on the Local Government, the utilization of water from the Springs of Senjoyo cooperation is mandatory, because it is undertaken in the form of inter-regions cooperation in the border area, and has a cross-regions externalities. In addition, the cross-border cooperation of the governance affairs causes the provision of public services more efficient if managed together. To carry out the mandatory cooperation, the Regency Government of Semarang should translate the inter-regions service into a formal cooperation agreement with the users of the springs. At the time this article was written, there is no formal cooperation agreement that is set as the foundation utilization of the springs.

The beneficiaries of the Springs of Senjoyo are varied. The PDAM of Salatiga City utilizes it to meet the needs of the raw water for servicing the people of the city. The textile company, PT. Damatex usage it as a source of raw water for the process industry. While the 411 Infantry Battalion Salatiga uses it as clean water to meet the needs of housing troops. Meanwhile, people around the springs used for many daily needs, such as for drinking, cooking, washing and bathing. While the Department of Irrigation and Water Resources of Central Java province uses it as irrigation water for a wide area around the city of Salatiga and the Regency of Semarang. Interaction between regions in the research discussed in this article is the use of cross-border Senjoyo Springs area in the border region Salatiga. This case is driven by the cross-border use of the Springs of Senjoyo located in the district he Semarang. Spring Senjoyo used as a source of raw water by the PDAM of Salatiga City to provide clean water for the people. Semarang regency government, as the official owner of the spring, allowing the use by its neighbors as a tribute to the tradition of the use of the eye by various parties that have lasted for a long time, since 1961.

On the basis of the interaction between regional background, can be determined that the neighboring areas around the Springs of Senjoyo, especially the City of Salatiga which gets the raw water supply services cross-border view that the border area is an area of the front page, as it allows regions of the services they get from the area their neighbors. The main reason is argued such area is due to their inability to provide services to the community. Meanwhile, Semarang regency government sees the area as a border region behind the region, because it allows its neighbor utilize its natural resources to meet the needs of its population.

Based on the perspective of these areas, it can be concluded that the City Government of Salatiga uses functional assertive collaboration strategies in the region interaction, because utilizing resources from neighboring areas, to meet the water needs of the population in the region. Meanwhile, the Regency Government of Semarang uses a strategy of cooperative collaboration between functional areas, because the government gives permissions to neighboring areas to take advantage of the resources available in the region. Unfortunately, these interactions have not been guided by a formal cooperation agreement. Both the interaction regions for the interaction of long-standing and become a tradition..

REFERENCES

- [1] J. K. Blatter, Border theory, in Encyclopedia of Governance. Thousand Oaks, CA, SAGE Publications, 2006, pp. 86-89.

- [2] J. W. Creswell, *Qualitative inquiry and research design: Choosing among five traditions*. London, Sage Publications, Inc., 1998.
- [3] B. Gray, *Collaborating: Finding common ground for multiparty problems*. San Francisco, CA, Jossey-Bass Publishers, 1989.
- [4] P. Healey, Debates in planning thought, in H. Thomas and P. Healey (editor): *Dilemmas of Planning Practice*. Avebury, Aldershot, 1991, pp. 91-97.
- [5] P. Healey, *Collaborative Planning: Shaping Places in Fragmented Societies (Planning, Environment, Cities)*. New York, Palgrave Macmillan, 2006.
- [6] S. Horowitz, Mediation; in C. Webel & J. Galtung (eds.), *Handbook of Peace and Conflict Studies*. London, Routledge, 2007, pp. 87-95.
- [7] M. Jones & I. Alony, "Guiding the use of Grounded Theory in Doctoral studies: An example from the Australian film industry." *International Journal of Doctoral Studies*, 6 (N/A), 2011, pp. 95-114.
- [8] R. D. Margerum, "Collaborative planning: Building consensus and building a distinct model for practice." *Journal of Planning Education and Research*; 21; 2002, pp. 237-248.
- [9] J. McCarthy, *Partnership, collaborative planning and urban regeneration*. Aldershot, Ashgate, 2007.
- [10] H. Mintzberg, *The Rise and Fall of Strategic Planning: Reconceiving Roles for Planning, Plans, Planners*. New York: The Free Press, 1994.
- [11] J. O'Flynn dan J. Wanna, *Collaborative governance: A new era of public policy in australia?* Canberra, ANU E Press, 2008.
- [12] R. O'Leary and N. Vrij, "Collaborative public management: Where have we been and where are we going?." *The American Review of Public Administration*, 42: 2012, pp. 507-516.
- [13] L. L. Riskin, "Understanding mediators' orientations, strategies and techniques: A grid for perplexed". *Harvard Negotiation Law Review*; 1996; 1:7; p. 7- 57.
- [14] S. Selden, J. Sowa & J. Sandfort, "The impact of nonprofit collaboration in early child care and education on management and program outcomes." *Public Administration Review*, 66 (3), 2002, pp. 412-425.
- [15] A. L. Strauss and J. M. Corbin, *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. London, Sage Publications, Inc., 1998.
- [16] K. W. Thomas., "Conflict and conflict management," in M. D. Dunnette (editor): *Handbook of Industrial and Organizational Psychology*. Chicago, Rand McNally, 1976, p. 889-935.
- [17] K. W. Thomas, Kenneth W. "Conflict and conflict management: Reflections and update," in *Journal of Organizational Behavior (1986-1998)*; 13, 3; ABI/INFORM Global: May 1992, pp. 265-278..

AUTHORS

First author - Hadi Wahyono, Doctoral students, Department of Urban and Regional Planning, Diponegoro University, hadiwahyono@yahoo.co.id.

Second Author - Achmad Djunaedi , Proffessor, Department of Architecture, Gajah Mada University, achmaddjunaedi@yahoo.com.

Third Author - Bakti Setiawan , Proffessor, Department of Architecture, Gajah Mada University, bobi.setiawan@yahoo.com.

Fourth Author - Leksono Subanu, Senior lecturer. Department of Architecture, Gajah Mada University, isubanu@gmail.com.

Correspondence Author – Hadi Wahyono, hadiwahyono@yahoo.co.id, +628122886465.

Survival Analysis of UIS patients under Parametric and Non-Parametric Approach using R software

Deepapriya. S and Ramanan. R

Department of Statistics, Presidency college, Chennai - 600 005

Abstract- The study of survival analysis involves censoring which is an important feature of the clinical data. This paper deals with the analysis of non-parametric and parametric estimates of survival function and median survival time of UMARU Impact Study (UIS) data. The Survival probabilities $S(t)$ are estimated by Kaplan Meier product Limit method under non-parametric approach and the survival functions are estimated through Weibull distribution, Exponential distribution and lognormal distribution under parametric approach. In modelling the survival data, most of the time we have no prior information about the theoretical distribution of survival time and graphical tools are employed to fit a better distribution using R Software.

Index Terms- censoring, Kaplan Meier estimate, parametric survival function, survival probability

I. INTRODUCTION

Survival analysis is a collection of statistical procedures for data analysis for which the outcome variable of interest is time until an event occurs. A special feature of survival data, which renders standard methods inappropriate, is that survival times are frequently censored. The exact survival times of the study subjects are unknown. That are called censored observation or censored times and can also occur when people are lost to follow up after a period of study. This paper deals with the survival analysis of University of Massachusetts AIDS Research Unit (UMARU) Impact Study (UIS) data under non Parametric and parametric method. Survival probabilities are estimated by Kaplan Meier Product limit method under non-parametric approach and the survival functions are estimated through Weibull distribution, exponential distribution and lognormal distribution under parametric approach. The non parametric technique (Kaplan-Meier, 1958) is applied to estimate the survival functions and hazard rates of the survival data. Estimating the distribution of the dependent variable without making assumptions about its shape is an important first step in analyzing a dataset [8]. Given the importance of the distribution of the dependent variable it is valuable to “let the data speak for itself” first. In biomedicine, prior knowledge about the distribution of survival function is appropriate to compare the survival functions [4]. Although non parametric methods play an important role in survival studies, parametric techniques cannot be ignored. Once an appropriate statistical model for survival time has been constructed and its parameters estimated, its information can help to predict survival, develop optimal treatment regimens, plan future clinical or laboratory studies [7]. R software is used to estimate survivor function Non-

parametrically, Parametrically by Weibull, exponential, Log-normal distribution for the UIS data.

1.1 Survivorship function

Let T be the survival time and $S(t)$ is the probability that an individual survives longer than t . i.e.,

$$S(t) = p(T > t) = 1 - p(T \leq t) = 1 - F(t),$$

Where $F(t)$ is the distribution function of the time t ,

$S(t)$ is non increasing function of time t with the properties

$$S(t) = 1 \text{ for } t = 0.$$

$$S(t) = 0 \text{ for } t = \infty.$$

$S(t)$ is known as the cumulative survival rate. The graph of $S(t)$ is called the survival curve.

II. NON PARAMETRIC METHOD

Non parametric analysis, estimating the probabilities without making any assumptions on its shape is called non-parametric analysis [8].

2.1 Kaplan- Meier method of estimation

Let n be the total number of individuals whose survival time, censored or not, are available. Relabeling the survival times in order of increasing magnitude such that $t_1 \leq t_2 \leq \dots \leq t_n$ and the values of r are consecutive integers $1, 2, \dots, n$ if there are no censored observation. If there censored observations, they are not. Then the survival probabilities are calculated using

$$s(t) = \prod_{t_r \leq t} \frac{n-r}{n-r+1}$$
 where r runs through those positive integers for which $t_r \leq t$ and t_r is uncensored. The variance of $s(t)$ is

approximated by $var[s(t)] = [s(t)]^2 \sum_r \frac{1}{(n-r)(n-r+1)}$ where r

includes those positive integer for which $t_{(r)} \leq t$ and t_r corresponds

to a death. Estimated standard error is $\sqrt{var(s(t))}$. 95% confidence interval for $s(t)$ is $s(t) \pm 1.96S.E[s(t)]$.

III. PARAMETRIC APPROACH

Parametric approaches are used either when a suitable model or distribution is fitted to the data or when a distribution can be assumed for the population from which the sample is drawn [8]. Commonly used survival distributions are the exponential, Weibull, lognormal, and gamma. In this paper AIC (Akaike Information Criterion)[4] is used for the selection of a Distribution that fit the data among the given.

3.1 Exponential distribution

The simplest and most important distribution in survival studies is the exponential distribution. The exponential distribution is characterized by a constant hazard rate λ , its only parameter. A high λ value indicates high risk and the short survival: a low λ value indicates low risk and long survival [4,5]. When the survival time T follows the exponential distribution with a parameter λ , the probability density function is referred as

$$f(t) = \begin{cases} \lambda e^{-\lambda t} & t \geq 0, \lambda > 0 \\ 0 & t < 0 \end{cases}$$

and survivorship function is then $S(t) = \exp[-\lambda t]$ $t \geq 0$, and the hazard function is $h(t) = \lambda$.

3.2 Weibull Distribution

Weibull distribution is one of these lifetime distributions, named after the Swedish physicist Waloddi Weibull(1936)[4,8]. The weibull distribution with two parameters has hypothetical confirmations in technical as well as biomedical applications as a purely empirical model.

The continuous random variable t has a weibull distribution with two parameters λ, γ and the density function is given by $f(t) = \gamma\lambda(\lambda t)^{\gamma-1} \exp[-(\lambda t)^\gamma]$ $t \geq 0, \lambda > 0, \gamma > 0$
Survivorship function is $S(t) = \exp[-(\lambda t)^\gamma]$
 $h(t) = \gamma\lambda(\lambda t)^{\gamma-1}$

weibull distribution has two parameters, where γ is the shape parameter and λ is scale parameter. At $\gamma < 1$, the failure rate decreases over time, at $\gamma = 1$ failure rate remains constant over time, and at $\gamma > 1$ failure rate increases over time.

3.3 Log-normal

Its origin may be traced as far back as 1879, when McAlister(1879) described explicitly a theory of the distribution. Most of its aspects have since been under study. Gaddum(1945) gave a review of its application in biology, followed by Boag's(1949) application in cancer research[4,5]. The Survival time T such that $\log T$ is normally distributed with mean μ and variance σ^2 . We then say that T is log normally distributed and write T as $\Lambda(\mu, \sigma^2)$. The log normal distribution is suitable for survival patterns with an initially increasing and then decreasing hazard rate [8].

The probability density function and the survivorship function are, respectively,

$$f(t) = \frac{1}{t\sigma\sqrt{2\pi}} e^{-\frac{1}{2\sigma^2}(\log t - \mu)^2} \quad t > 0, \sigma > 2$$

$$S(t) = \frac{1}{\sigma\sqrt{2\pi}} \int_t^\infty \frac{1}{x} e^{-\frac{1}{2\sigma^2}(\log x - \mu)^2} dx$$

The popularity of the distribution is due in part to the fact that the cumulative values of $y = \log t$ can be obtained from the tables of the standard normal distribution and corresponding values of t are then found by taking antilogs.

3.4 R Software

R software is used to find survival probabilities under non parametric approach [11], survival curves and fitting the survival distributions parametrically. First install package survival using `>install.packages('survival')`
To load libraries, use

`>library(survival)`

IV. COMPUTATION AND CALCULATION

The data set contains 628 subjects are considered without incorporating the covariates a null model is being fitted for the survival times of the data.

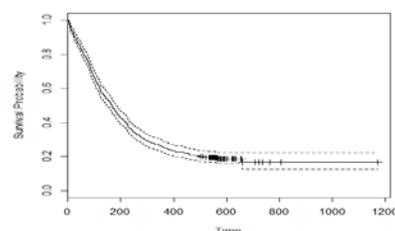
Table 4.1 (Survival Probability Obtained By Kaplan Meier Estimator)

Time	n.risk	n.event	Survival probabilities	std.err	lower 95% CI	upper 95% CI
2	628	1	0.998	0.00159	0.995	1
3	627	3	0.994	0.00317	0.987	1
4	624	4	0.987	0.00448	0.979	0.996
5	620	4	0.981	0.00546	0.97	0.992
6	616	3	0.976	0.00609	0.964	0.988
7	613	4	0.97	0.00684	0.956	0.983
8	609	2	0.967	0.00717	0.953	0.981
9	607	2	0.963	0.0075	0.949	0.978
10	605	4	0.957	0.00809	0.941	0.973
11	601	3	0.952	0.00851	0.936	0.969
12	598	2	0.949	0.00878	0.932	0.966
13	596	1	0.947	0.0089	0.93	0.965
14	595	4	0.941	0.0094	0.923	0.96
15	591	3	0.936	0.00974	0.917	0.956
17	588	1	0.935	0.00986	0.916	0.954
18	587	1	0.933	0.00997	0.914	0.953
19	586	2	0.93	0.01019	0.91	0.95
20	584	2	0.927	0.0104	0.907	0.947
.
.
.
491	129	1	0.204	0.01607	0.175	0.238
494	128	1	0.202	0.01603	0.173	0.236
499	127	1	0.201	0.01598	0.172	0.235
502	125	1	0.199	0.01593	0.17	0.233
516	120	1	0.197	0.01589	0.169	0.231
519	119	1	0.196	0.01584	0.167	0.229
559	54	1	0.192	0.01596	0.163	0.226
568	38	1	0.187	0.01632	0.158	0.222
659	9	1	0.166	0.02438	0.125	0.222

The survival fit obtained using the following R code for UIS data.

```
us=read.table("d:rprog/usd.csv",header=T,sep=",")
kmpl=survfit(Surv(TIME,CENSOR)~1,data=us)
summary(kmpl)
plot(kmpl)
```

fig. 4-1 Kaplan Meier survival curve



The survival probabilities are obtained using the KM fit the curve obtained as a smooth curve for only 18% of censoring has occurred and also the event time are immediate [7]. The median survival time estimated Non-parametrically as 208 day.

Table 4.2(Parametric estimation of UIS data)

	(Intercept)	Scale	Loglik	AIC
Weibull	5.654021	1.138789	-3382	6768.022
Exponential	5.670383	1	-3388.6	6770.28
Lognormal	5.096428	1.419206	-3368	6739.905

```
weibull .null<- survreg(data = us, Surv(TIME,CENSOR) ~ 1,
dist = "weibull")
plot(x = predict(weibull, type = "quantile", p = seq(0.01, 0.99,
by=.01))[1,],
y = rev(seq(0.01, 0.99, by = 0.01)), col = "red")
```

```
Expo.null<- survreg(data = us, Surv(TIME,CENSOR) ~ 1, dist =
"weibull")
plot (x = predict(Expo.null, type = "quantile", p = seq(0.01, 0.99,
by=.01))[1,],
y = rev(seq(0.01, 0.99, by = 0.01)), col = "green")
```

```
lognormal <- survreg(data = us, Surv(TIME,CENSOR) ~ 1, dist =
"lognormal")
lines(x = predict(lognormal, type = "quantile", p = seq(0.01,
0.99, by=.01))[1,],
y = rev(seq(0.01, 0.99, by = 0.01)), col = "blue")
```

A null model for the Exponential weibull, and log normal distribution is obtained by the above R code and scale obtained by weibull fit(table.1.2) is 1.138789 nearly equals 1 and is a special case of exponential and a exponential can also a better fit for this data. The intercept of exponential fit is 5.670, $\lambda = \exp(-\text{intercept}) = 0.003448$, $\mu = 1/0.003448 = 290$ days. The mean survival time obtained by exponential fit is 290 days and the median survival time $t_{0.5} = -\log 0.5/\lambda = 201$ days. The two parameter of the weibull distribution are obtained from the weibull fit are $\lambda = \exp(-\text{intercept}) = 0.00350$, and $\mu = 1/\text{scale} = 0.878$. The estimated parameters of log normal distribution are $\mu =$

intercept = 5.0964 and $\sigma^2 = \text{scale}^2 = 1.4192$ and the mean survival time obtained from the log normal fit is 296 days. The survival probabilities for the above mention distribution are obtained from the estimated parameter of the survival fit using the R codes are given in the table (1.3). The log likelihood and the AIC obtained under the fit table (1.2) exhibits log normal is a suitable model for the above mentioned data.

Table 4.3. Estimated survival probabilities from parametric fit.

Time	Censor	Estimated Survival Probabilities		
		Exponential	Weibull	Lognormal
2	1	0.993128	0.988431	0.999996
3	1	0.98971	0.983389	0.999973
4	1	0.986303	0.978542	0.999913
5	1	0.982908	0.973841	0.999795
6	1	0.979525	0.969257	0.999601
7	1	0.976154	0.964772	0.999316
8	1	0.972794	0.960371	0.998928
9	1	0.969446	0.956046	0.99843
10	1	0.966109	0.951789	0.997814
11	1	0.962784	0.947593	0.997077
12	1	0.95947	0.943455	0.996216
13	1	0.956167	0.939369	0.995232
14	1	0.952876	0.935332	0.994125
15	1	0.949597	0.931342	0.992897
17	1	0.943071	0.92349	0.990085
18	1	0.939825	0.919625	0.988508
19	1	0.93659	0.915797	0.986821
20	1	0.933367	0.912006	0.985029
21	1	0.930154	0.90825	0.983135
22	1	0.926952	0.904526	0.981145
23	1	0.923762	0.900836	0.979061
.
.
.
655	0	0.104523	0.120419	0.22986
658	0	0.103447	0.119374	0.229278
659	0	0.103091	0.119028	0.229086
708	0	0.087066	0.103306	0.220447
720	0	0.083537	0.099799	0.218549
734	0	0.079601	0.095864	0.216431
762	0	0.072275	0.088475	0.212487
763	0	0.072026	0.088222	0.212353
805	0	0.062316	0.078266	0.207101
1172	0	0.017582	0.028147	0.181076

4.1 Graphical representation of survival function using R

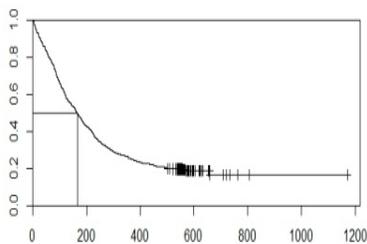


Fig 4 - 1 Kaplan-Meier Estimator

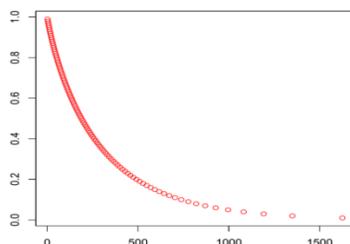


Fig 4 - 2 Weibull

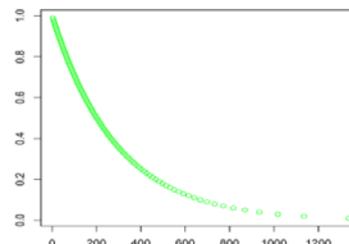


Fig 4 - 3 Exponential

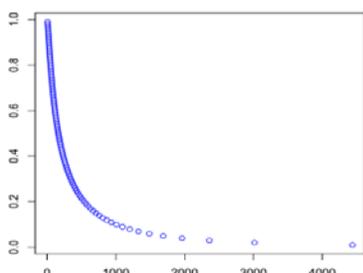


Fig 4 - 4 Lognormal

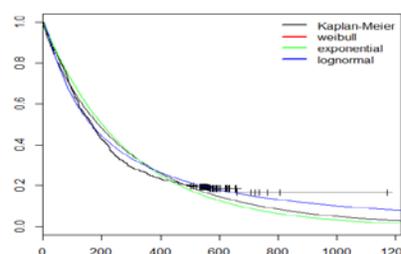


Fig 4 - 5 Non-parametric and parametric survival function

V. CONCLUSIONS

On the analysis of UIS data the estimated survival probabilities were given in the table (4.1) & (4.3) and the median survival time was calculated graphically as 166 days under Non parametric approach. The survivorship curves obtained by Kaplan Meier method under Non-Parametric approach and also by parametric method Exponential, Weibull and Log-normal can be visualised from fig(4.5) there is no significance difference between the estimates of survivorship function obtained by parametric and non parametric method. On a comparison with the parametric distributions log normal is found to be a better fit in accordance with the AIC value for the UIS data, moreover the scale parameter obtained by weibull is nearly 1 which can be reduced to exponential survival function so obtained for the UIS data.

REFERENCES

- [1] Altman DG, Bland JM.(1998),” Time to event (survival) data”. British Medical Journal (BMJ); vol. 317:pp. 468-469.
- [2] Altman DG, Bland JM.(1998), “Survival probabilities (The Kaplan-Meier method)”. BMJ; vol. 317; pp.1572 - 1580.
- [3] Collett D. (2003), “Modeling of Survival Data in Medical Research”. Chapman Hall, London, U.K.
- [4] Elisa T. Lee. (1992), “Statistical methods for Survival Data Analysis”. Second Edition. A Wiley-Inter science publication, United States of America.

AUTHORS

First Author – S. Deepapriya, M.Sc.(Maths), M.Phil. (Maths), M.Sc. (Stats), Research Scholar, Presidency college, Chennai. Email – sbdpriya@gmail.com
Second Author – Dr.. R Ravanan, M.Sc., M.Phil., Ph.D., Head, Department of statistics, Presidency college, Chennai. Email – ravananstat@gmail.com

- [5] German Rodriguez, grodri@princeton.edu, Parametric Survival Models, Spring, 2001; revised Spring 2005, Summer 2010
- [6] Kaplan, E. L., and Paul Meier (Jun. 1958),” Non parametric Estimation from Incomplete Observations”, Journal of the American Statistical Association. Vol. 53, pp457 – 481.
- [7] Kleinbaum, D.G. (1996). Survival analysis. New York: Springer-Verlag.
- [8] Maryam Siddiq, Mueen - ud -Din Azad, Muhammad Khalid Pervaiz, Muhammad Ghias, Gulzar H. Shah, Uzma Hafeez Survival analysis of dialysis patients under parametric and non-parametric approaches, Electronic Journal of Applied Statistical Analysis, EJASA (2012), Electron. J. App. Stat. Anal., Vol. 5, Issue 2, 271 – 288
- [9] Maarten L. Buis, Department of Social Research Methodology, Vrije Universiteit Amsterdam, mbuis@fsw.vu.nl, April 2, 2006, An introduction to Survival Analysis
- [10] Rupert G. Miller J R (1981), “Survival Analysis”, John Wiley & Sons, United States of America.
- [11] Ramakrishnan, M. Ravanan, R. Estimation of Survival Distribution Using R Software International Journal of Scientific and Research Publications, Volume 3, Issue 4, April 2013 1, ISSN 2250-3153

Subclinical Neck Nodes in early stages of Oral Tongue Cancer: Evaluation and Comparison with HPE

Dr. Ila Upadhya*, Dr. Mithun Jain**.

* Associate Professor, Department of ENT & HNS, Government Medical College & New Civil Hospital, Surat, India.

** Senior Resident, Department of ENT & HNS, Government Medical College & New Civil Hospital, Surat, India.

Abstract- Oral tongue cancers are very aggressive, known for skip metastasis, high recurrence rates and poor salvage results. Strong et al^[3] stated that 60% of patients died of neck recurrence when they were managed by only resection of primary and observation of neck^[3]. SOHND [Supra omohyoid neck dissection] is not adequate enough for complete pathological evaluation of all neck nodes at risk for patients of oral tongue malignancy.^[2]

Index Terms- Oral; tongue; metastasis; cancer; MRI

I. INTRODUCTION

The best evaluation method to detect occult neck nodes is very challenging. Management of subclinical cervical nodes in cancers of anterior $2/3^{\text{rd}}$ of tongue remains to be controversial. Doing SOHND (Supra omohyoid neck dissection) N0 Neck is not sufficient due to the occurrence of skip metastasis.^[1, 2] Results of salvage neck dissection after appearance of neck nodes are not very appealing^[3]. Elective MND-III (modified neck dissection – Type III) in N₀ neck does not improve the survival^[4]

A prospective study was conducted to know the best pre-operative evaluation method in comparison of HPE (Histo-Pathology Examination) of specimen of tongue excision and neck dissection to predict the subclinical neck nodes in early stage of oral tongue cancer.

1) Abstract

Aims and objectives: To evaluate the efficacy of prevailing methods of investigations to know the occurrence of subclinical neck nodes in early lesions of oral tongue malignancy.

Study Design: Prospective case series

Protocol: Early lesions of oral tongue cancer were evaluated by clinical examination, MRI [Magnetic resonance imaging] of oral cavity and neck, USG [Ultra Sonography] of neck. They were compared with histopathology with regards to neck nodes, cell differentiation, and depth of tumor invasion as all underwent wide excision of primary with type III MND [Modified neck dissection].

Results: USG has high sensitivity, specificity, positive and negative predictive value for neck nodes. MRI is a good tool to predict depth of tumor invasion which is a significant factor for local and cervical control, Differentiation of cell and depth of tumor invasion on HPE are a significant predictor of neck nodes

2) Introduction

Oral tongue cancers are very aggressive, known for skip metastasis, high recurrence rates and poor salvage results. Strong et al^[3] stated that 60% of patients died of neck recurrence when they were managed by only resection of primary and observation of neck^[3]. SOHND [Supra omohyoid neck dissection] is not adequate enough for complete pathological evaluation of all neck nodes at risk for patients of oral tongue malignancy.^[2]

3) Research Elaborations

Study Design: Prospective case study

Materials and methods: A prospective study of 30 cases of carcinoma of oral tongue was carried out from July 2009 to December 2011 at Department of E.N.T. and Head and Neck, Govt. Medical College & New Civil Hospital, Surat. India.

Inclusion Criteria: All patients having T₁, T₂ lesions of carcinoma of tongue arising from anterior ²/₃rd of tongue were included.

Exclusion Criteria:

1. The patients previously treated and those who refused to give consent for study.
2. Patients not willing for regular follow up or did not turn up for regular follow up.
3. All patients with distant metastasis and major general debilitating disease.

Prerequisite:

1. The study design was thoroughly scrutinized and passed by Ethical committee of our institute.
2. All patients were informed, explained in detail about the study & only those patients were included in the study who gave written consent for the same.

Protocol: Each patient, included in the study was admitted in the ward, detailed history was taken, thorough local, general and systemic examination was performed. Pathological diagnosis was established by biopsy. Ultra sonography and MRI (Magnetic resonance imaging) of neck for neck nodes were done; FNAC (Fine Needle aspiration cytology) was done for palpable nodes and USG (Ultra Sonography) guided FNAC was done for impalpable nodes. TNM staging was done based on MRI which was done 5 to 7 days before final management.

All the patients underwent curative surgery as primary treatment in the form of wide excision of tongue with 2cm safety margins for primary. Modified type 3 neck dissection was done (for N + neck i.e. more than 1cm neck node on MRI and/or when the depth of tumor invasion was more than 3mm on MRI). Surgical specimen was sent for HPE after proper labeling of all margins and final staging was done based on HPE. Post-operative full dose radiotherapy was advised when indicated. Follow up at regular interval was carried out monthly for 6 months and 3 monthly thereafter. Local & Regional recurrence if any was treated appropriately.

4) Results or Finding

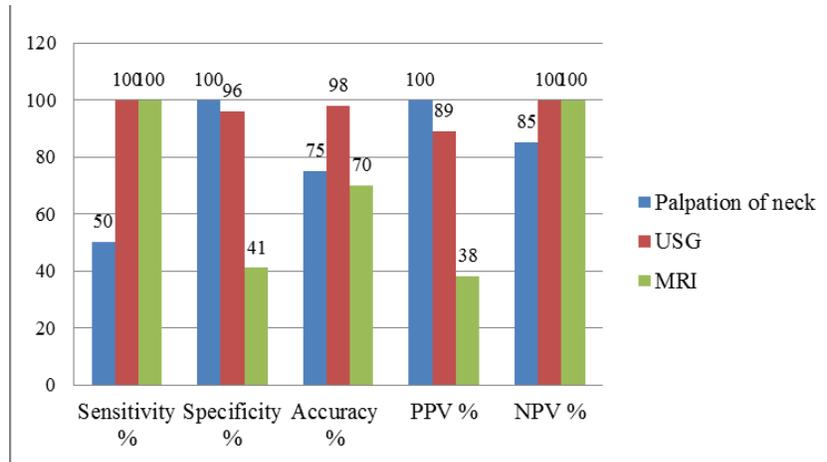
Our study comprised of 17 males and 13 females, with male to female ratio of 1.3 : 1, in the age group of 21-80 years, with mean age of presentation being 50 years. In this study, only 3 patients were without any additions. 27 patients were addicted to tobacco and in addition, two of them were consuming alcohol. The most common site of lesion was lateral margin of tongue in 96.66% patients, whereas only one patient had growth on ventral surface of tongue (3.33%).

In this study we observed that 76.66% of lesions were ulcerative, 16.66% were endophytic and only 6.66% were exophytic.

Table 1: N staging based on different investigations:

N Stage	N ₀	N ₁	N ₂
Palpation of neck	26	04	0
USG Neck	21	09	0
MRI Neck	9	19	02
FNAC	Not Possible	Inconclusiv e	Inclusive
HPE	22	06	02

In our study we found the following statistical value for each method of evaluation of neck node as mentioned in Graph 1



Graph 1: Statistical value of different investigations for neck nodes

Chi Square = 26.26
 DF (Degree of Freedom) = 6
 P (Probability) = 0.0002
 (PPV = Positive Predictive Value, NPV = Negative Predictive Value)

Out of 26 patients of N₀ stage, 5 were upgraded to N₁ on USG and 17 were upgraded to N₁ on MRI Neck. This is indicative of USG as more sensitive to pick up impalpable neck nodes with sensitivity of 100% and specificity of 96% compared to MRI.

On MRI of neck, we found 9 patients with N₀ and 21 with positive neck node. For neck node positivity standard criteria were taken into consideration. We found sensitivity and specificity of MRI to be 100% and 41 % respectively.

Table 2: T staging based on different investigations:

	T ₁ Stage	T ₂ Stage	T ₃ Stage (4.1 cm)
Clinical Examination	21	09	0
MRI	14	14	02
HPE	05	22	03

Chi Square = 18.18
 DF = 4
 P = 0.0011

When different evaluation methods were compared with T staging the P = 0.001 which was highly significant.

Above table shows that clinical examination underestimates the tumor which on MRI gets upgraded. 8 patients of RT₁ (Radiological) on MRI were upgraded to pT₂ (pathological) and one patient of RT₂ was upgraded to pT₃ on HPE.

Table 3: Comparison of T stage with N staging on HPE

	N ₀ (MRI/HPE)	N ₁ (MRI/HPE)	N ₂ (MRI/HPE)
T ₁	7/2	6/2	1/1
T ₂	2/19	11/2	1/1
T ₃	0/1	2/2	0/0

Chi-square = 9.18
 DF = 4

P = 0.057

but on MRI,
 Chi-square = 5.63
 DF = 4
 P = 0.229

For MRI above data are indicative that size of the tumor is directly proportional to neck node metastasis as both patients with T₃ came as positive neck node on microscopic examination. Correlation of T stage with N stage is significant on HPE as P value is 0.057 but MRI does not correlate the same significantly as P value is 0.229.

Table 4: Pathological cell differentiation and Correlation with N stage.

N Stage	N ₀	N ₁	N ₂
Well differentiated	18	0	0
Moderately differentiated	02	02	01
Poorly Differentiated	02	04	01

This shows significant correlation between grade of differentiation and neck node involvement with;
 Chi square = 17
 DF = 4
 P = 0.002

Table 5: Comparison of depth of tumor invasion with T stage on MRI/HPE

	T ₁ (MRI/HPE)	T ₂ (MRI/HPE)	T ₃ (MRI/HPE)
< 3mm	0/0	0/0	0/0
3 to 9mm	7/5	0/8	0
> 9mm	7/0	14/14	2/3

For MRI;
 Chi-square = 10.4
 DF = 2
 P = 0.005

and for HPE
 Chi-square = 9.27
 DF = 2
 P = 0.010

The above table shows that as the size of lesion increases the depth of invasion to deeper structure of tongue also increases. When depth of tumor invasion was compared with T staging for MRI, P = 0.005 and for HPE, P = 0.01 both are highly significant.

As none of our patients had depth of tumor invasion < 3mm on MRI all were posted for MND type 3, 22 came as negative for metastasis on HPE and 08 came as positive for metastasis indicating that MRI over estimates the nodes.

Table 6: Comparison of depth of tumor invasion with N stage on MRI/HPE

	N ₀ (MRI/HPE)	N ₁ (MRI/HPE)	N ₂ (MRI/HPE)
< 3mm	0/0	0/0	0/0
3 to 9mm	5/22	1/2	0/0
> 9mm	4/0	18/4	2/2

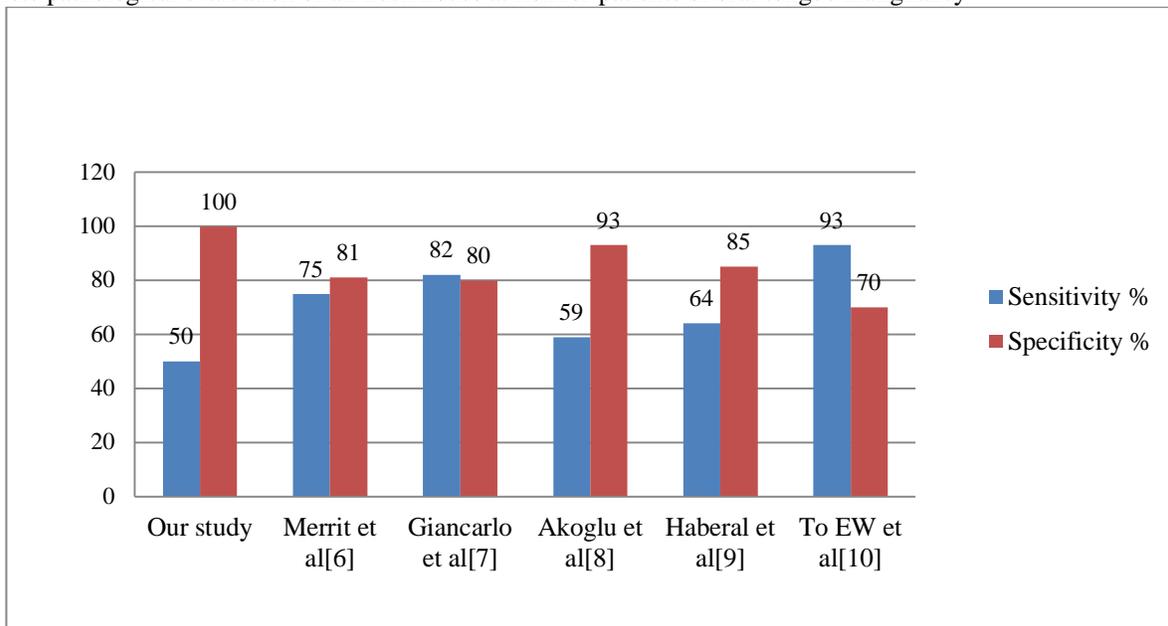
MRI;
Chi-square = 10.2
DF= 2
P= 0.006

and HPE
Chi-square = 21.7
DF= 2
P = 0.000

This suggests that depth of invasion is good indicator of possibility of neck metastasis on MRI as well as HPE. For tumor thickness 3 to 9mm, $\frac{1}{6}$ (16%) on MRI and $\frac{2}{24}$ (8%) on HPE were found to have neck nodes. For tumor thickness > 9mm, $\frac{20}{24}$ (83%) on MRI and $\frac{6}{6}$ (100%) were found to be neck node positive on HPE.

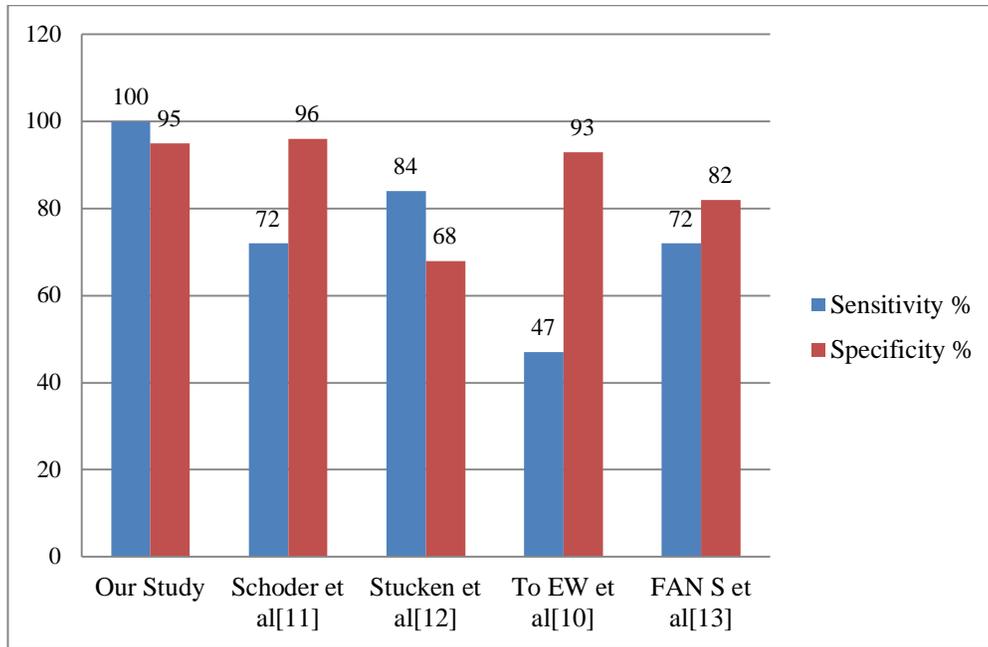
Discussion:

Cancer of tongue comprises of 35 % of all oral cavity cancers. ^[16] In our study it was 31%. These lesions are very aggressive, known for skip metastasis, high recurrence rates and poor salvage results. Strong et al ^[3] stated that 60% of patients died of neck recurrence when they were managed by only resection of primary and observation of neck .Primary aggressive intervention yields better results keeping in mind the functional morbidity of tongue excision and neck dissection ^[3]. SOHND is not adequate enough for complete pathological evaluation of all neck nodes at risk for patients of oral tongue malignancy ^[11].



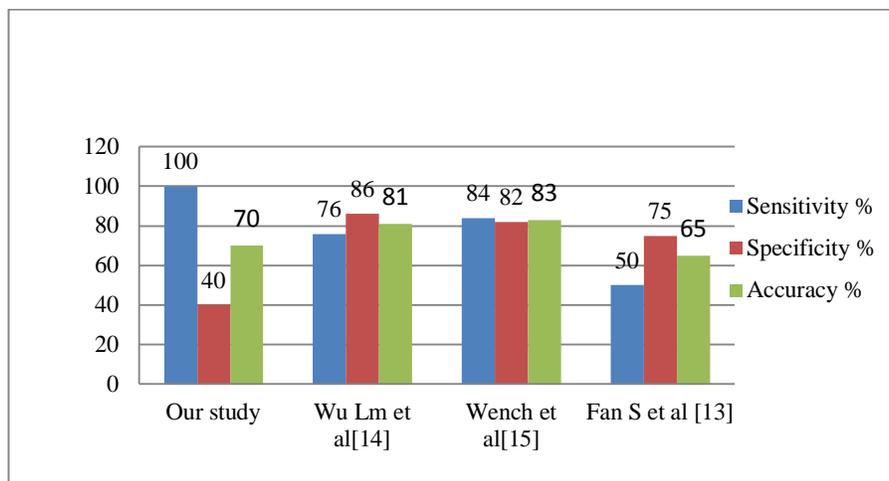
Graph 2: Comparison of statistical values with other studies on palpation of neck

Merritt et al. ^[6] in a systematic review of studies comparing palpation with computed tomography (CT), found a sensitivity of 75% and 83% and a specificity of 81% and 83% for palpation and CT, respectively. Giancarlo et al. ^[7] comparing palpation with ultrasonography (US) found no differences between the methods, and palpation had a sensitivity of only 82% and specificity of 80%. Akoglu et al. ^[8] studied 23 patients and found a sensitivity for palpation of 59.2% and a specificity of 93%. Haberal et al ^[9] documented sensitivity of 64% and specificity of 85%. To EW et al ^[10] found sensitivity of 93% and specificity of 70%. We got 50 % sensitivity and 100% specificity on palpation of neck.



Graph 3: Comparison of statistical values with other studies on USG

On USG the sensitivity and specificity was found to be 100% and 95% in our study which was comparable with Akoglu et al^[8] as 80 % and 59 % respectively., Haberal et al^[9] documented the same as 72% and 96% respectively. The sensitivity, specificity and accuracy were found to be 47%, 93% and 70%, respectively in a study by To EW et al^[10] Schoder et al^[11] documented 72% sensitivity and 96% specificity by USG. The sensitivity and specificity for USG by Stuken et al^[12] (84% & 68%), EMW et al^[10] (47% & 93%) FAN et al^[13] (72.5% & 82.1%) is documented in the literature.



Graph 4: Comparison of statistical values with other studies on MRI

Wu LM et al^[14] found sensitivity of 76 % with specificity of 86 % for MRI. A Meta-analysis conducted by Wenche M Klerkx et al^[15] found sensitivity of 0.84 (95% CI = 0.70 to 0.92), with a specificity of 0.82 (95% CI = 0.72 to 0.89) for the nine studies that incorporated contrast enhancement in their multiple malignancy criteria for MRI. Whereas Fan S et al^[13] documented it to be 50 % and 75 % respectively for MRI.

Lam P et al^[16] found significant accuracy for measurement of tumor thickness and staging on contrast enhanced T₁-weighted and T₂ weighted MRI when compared with histology tumor thickness (R = 0.938 and 0.941, respectively).

Po wing et al found^[17], tumor of up to 3 mm thickness has 8% subclinical nodal metastasis, tumor thickness of more than 3mm and up to 9mm had 44% subclinical nodal metastasis, tumor of more than 9 mm had 53% subclinical nodal metastasis.

Fukano et al ^[18] found overall cervical metastatic rate to be 35.4% and depth of invasion was statistically significant predictors of regional metastasis $p = 0.0003$ on HPE compared to our study where the same was 26% and $P = 0.000$, highly significant.

Morton RP et al ^[19] found no association between tumor thickness and nodal metastasis. Perineural infiltration was the only factor to approach statistical significance.

Veness M J et al ^[20] found tumor thickness ≤ 5 mm versus > 5 mm the incidence of nodal metastases was 8% versus 51% ($P = 0.007$).

In our study when depth of tumor invasion was compared with neck nodes MRI turned out to be a good indicator with $P = 0.006$.

5) Conclusion

- Preoperative USG of the neck is best investigation to predict subclinical neck node with sensitivity of 100% and specificity of 95%.
- T stage on MRI is not a significant criterion to predict cervical metastasis $P = 0.229$, but the same for HPE is $P = 0.057$.
- Cell differentiation on HPE correlates significantly with occurrence of neck node $P = 0.002$.
- Depth of tumor invasion on MRI correlates very well with T staging $P = 0.005$, the same for HPE, $P = 0.01$ highly significant.
- Depth of tumor invasion on MRI is one of the significant criteria to predict sub clinical micro metastasis $p = 0.006$, the same for HPE, $P = 0.00$ very significant.

REFERENCES

- [1] Byers RM, Weber RS, Andrews T, McGill D, Kare R, Wolf P. Frequency and therapeutic implications of "skip metastases" in the neck from squamous carcinoma of the oral tongue. *Head Neck* 1997;19:14-9. [PubMed]
- [2] Johnson JT, Leipzig B, Cummings: Management of T 1 carcinoma of anterior aspect of tongue. *Arch otolaryngol* 106:249-251,1980
- [3] Strong EW: Carcinoma of tongue. *Otolaryngol Olin North America* 12:107-114,1979
- [4] Southwick HW et al, S Laughter DP et al: Elective neck dissection for intraoral cancer, *Arch Surg* 80:905-909,1960
- [5] Richrd W. Nason et al, Barry Anderson et al, Devon S. Gujarathi et al, Manitoba university, Canada, treatment outcome of squamous cell carcinoma of oral tongue, *American journal of Surgery* 172:665-670,1996
- [6] Merritt RM, Williams MF, James TH, Porubsky ES. Detection of cervical metastasis. A meta-analysis comparing computed tomography with physical examination. *Arch Otolaryngol Head Neck Surg* 1997;123:149-52. [PubMed]
- [7] Giancarlo T, Palmieri A, Giacomarra V, Russolo M. Pre-operative evaluation of cervical adenopathies in tumours of the upper aerodigestive tract. *Anticancer Res* 1998;18:2805-9. [PubMed]
- [8] Akoglu E, Dutipek M, Bekis R, Degirmenci B, Ada E, Guneri A. Assessment of cervical lymph node metastasis with different imaging methods in patients with head and neck squamous cell carcinoma. *J Otolaryngol* 2005;34:384-94. [PubMed]
- [9] Haberal I, Celik H, Gocmen H, Akmansu H, Yoruk M, Ozeri C. Which is important in the evaluation of metastatic lymph nodes in head and neck cancer: palpation, ultrasonography, or computed tomography? *Otolaryngol Head Neck Surg* 2004;130:197-201. [PubMed]
- [10] To EW, Tsang WM, Cheng J, Lai E, Pang P, Ahuja AT, Ying M. Is neck ultrasound necessary for early stage oral tongue carcinoma with clinically N0 neck? *Dentomaxillofac Radiol.* 2003 May;32(3):156-9. PubMed PMID: 12917280.
- [11] Schoder H, Carlson DL, Kraus DH, Stambuk HE, Gonen M, Erdi YE, et al. 18F-FDG PET/CT for detecting nodal metastases in patients with oral cancer staged N0 by clinical examination and CT/MRI. *J Nucl Med* 2006;47:755-62. [PubMed]
- [12] Stuckensen T, Kovacs AF, Adams S, Baum RP. Staging of the neck in patients with oral cavity squamous cell carcinomas: a prospective comparison of PET, ultrasound, CT and MRI. *J Craniomaxillofac Surg* 2000;28:319-24. [PubMed]
- [13] Fan S, Zhang Q, Li Q, Wang L, Zheng L, Liu L. [Identification of cervical lymph node micrometastasis of tongue cancer by color Doppler and MRI]. *Zhonghua Er Bi Yan Hou Tou Jing Wai Ke Za Zhi.* 2014 Jan;49(1):39-43. Chinese. PubMed PMID: 24680336.
- [14] Wu Lm et al Wu LM, Xu JR, Liu MJ, Zhang XF, Hua J, Zheng J, Hu JN. Value of magnetic resonance imaging for nodal staging in patients with head and neck squamous cell carcinoma: a meta-analysis. *Acad Radiol.* 2012 Mar;19(3):331-40. doi: 10.1016/j.acra.2011.10.027. Epub 2011 Dec 6.
- [15] Wenche M Klerkx; Leon Bax; Woufenuer B Veldhuis ; A Peter. M. Heinz; Willem P ThM Mali; Petra H M Peeters; Karel G.M. Moons. Detection of Lymph Node Metastasis by Gadolinium-enhanced Magnetic Resonance Imaging: Systemic Review and Meta analysis. *JNCI* 2010;102(4):244-253
- [16] Lam P et al Lam P, Au-Yeung KM, Cheng PW, Wei WI, Yuen AP, Trendell-Smith N, Li JH, Li R. Correlating MRI and histologic tumor thickness in the assessment of oral tongue cancer. *AJR Am J Roentgenol.* 2004 Mar;182(3):803-8. PubMed PMID: 14975989.
- [17] Po Wing Yuen A, Lam KY, Lam LK, Ho CM, Wong A, Chow TL, Yuen WF, Wei WI. Prognostic factors of clinically stage I and II oral tongue carcinoma-A comparative study of stage, thickness, shape, growth pattern, invasive front malignancy grading, Martinez-Gimeno score, and pathologic features. *Head Neck.* 2002 Jun;24(6):513-20. PubMed PMID: 12112547.
- [18] Fukano H, Matsuura H, Hasegawa Y, Nakamura S. Depth of invasion as a predictive factor for cervical lymph node metastasis in tongue carcinoma. *Head Neck.* 1997 May;19(3):205-10. Review. PubMed PMID: 9142520.
- [19] Morton RP et al found Morton RP, Ferguson CM, Lambie NK, Whitlock RM. Tumor thickness in early tongue cancer. *Arch Otolaryngol Head Neck Surg.* 1994 Jul;120(7):717-20. Review. PubMed PMID: 8018323.
- [20] Veness MJ, Morgan GJ, Sathiyaseelan Y, GebSKI V. Anterior tongue cancer and the incidence of cervical lymph node metastases with increasing tumour thickness: should elective treatment to the neck be standard practice in all patients? *ANZ J Surg.* 2005 Mar;75(3):101-5. PubMed PMID: 15777383.

AUTHORS

First Author – Dr. Ila Upadhyia, MS (ENT), DLO, Fellow in Surgical Oncology, Government Medical College, Surat, India. ila.upadhyia@gmail.com

Second Author – Dr. Mithun Jain, MS (ENT), Government Medical College, Surat, India (Sr. Resident during the research period).

Correspondence Author – Dr. Ila Upadhyia, ila.upadhyia@gmail.com, +91 98251 49402

Analysis of Relative Humidity in Iraq for the Period 1951-2010

Abdulwahab H. Alobaidi

Department of Electronics, Institute of Technology, Middle Technical University, Baghdad, Iraq

Abstract- The analysis of trends in temperature, precipitation, and relative humidity and evaluating their statistical significance have recently received a great concern for the assessment climate change effects. This research is to analyze a long time record of surface relative humidity for four cities, representing different climate zones, in Iraq using NCEP data. Parametric linear regression and nonparametric Mann–Kendall tests were applied for detecting monthly and annual trends in the relative humidity. The monthly time series showed that relative humidity is decreasing during winter, spring and autumn months. The decreasing trend during summer months is relatively weaker. This because summer in Iraq is hot and dry so changes in relative humidity is small. The annual relative humidity also exhibited a decreasing trend for the four cities. The results also illustrated that the decreasing trend in relative humidity is relatively stronger for Mosul because of it rather cooler climate and relatively smaller for the southern city of Basrah.

Index Terms- Relative humidity, Time series, Mann-Kendall, Iraq

I. INTRODUCTION

The climate system of the Earth is ever changing across all space and time scales. Evidence for past changes arises from “proxies” such as ice cores and geological records, and for more recent times from tree rings, coral growth, and historical documentary records. Only over the last two Centuries the atmosphere have been actively measured. Since the late 18th Century, measurements by thermometers and other surface instruments on land have been available along with measurements made by ships. After the Second World War, balloon-based sounding of the free atmosphere began and finally, since the 1970s satellites have also been employed to monitor the climate system. To date, climate data record construction efforts have principally considered temperature and to a lesser extent pressure and precipitation. However, even taken together these are an incomplete diagnostic of the climate system and do not adequately constrain our understanding. Humidity, both relative and absolute, is potentially a very insightful tool for climate research. In addition, humidity has important implications for Climate Impact studies including human heat stress [1].

Analyzing long-term trends in hydroclimatic parameters and assessing their statistical significance are fundamental tools in the detection of climate change [2]. Recently, many scientists with analyzing trends in hydroclimatic parameters attempted to clarify whether or not there is an obvious climate change [3][4][5][6][7]. Compared with the analysis of air temperature and precipitation records, a few studies have been carried out to examine the trends of relative humidity and dew point temperature searching for evidence of climate change. Gaffen and Ross (1999) [8] studied the trends of relative humidity and dew point temperature in the United States for the period 1951–1990. They found that relative humidity trends were weaker than specific humidity trends. van Wijngaarden and Vincent (2003) [9] assessed changes in relative humidity in Canada over the period 1953–2003 and found a substantial decrease in relative humidity throughout the country. Abu-Taleb et al. (2007) [10] examined recent changes in annual and seasonal relative humidity in Jordan. Their analysis showed an increasing trend in the relative humidity time series at different stations which were found to be statistically significant during summer and autumn seasons. Wright et al. (2010) [11] analyzed the zonal mean relative humidity changes in a warmer climate. They found that relative humidity changes near the extratropical tropopause and in the lower troposphere are largely dependent on changes in the distribution and gradients of temperature. Talee et al. (2012) [12] reported on observed changes in relative humidity and dew point temperature in coastal regions of Iran. Their results showed that annual relative humidity increased by 1.03 and 0.28% per decade while annual dew point temperature increased by 0.29 and 0.15°C per decade at the northern and southern regions, respectively. Frimpong et al. (2014) carried out an extensive analyses of trends in mean annual and mean seasonal minimum and maximum temperatures and relative humidity were examined for Bawku East, northern Ghana, for the period 1961 to 2012. They concluded that there declining trends in relative humidity were observed at 6 am and 3 pm at seasonal and annual levels at Binduri and Garu, while there was a rising trend in relative humidity at Manga. The aim of this work is to analyze long term records of relative humidity in Iraq. NCEP data for the period 1951-2010 were used for four stations located in the different climate zones of Iraq.

II. MATERIALS AND METHOD

In this research surface relative humidity data from the National Center for Environmental Prediction (NCEP) were used. Data are available for the period from 1951 to 2010. Relative humidity data for four cities representing different climate zones in Iraq were analyzed. Table I gives the geographical coordinates of these cities.

Table I: The geographical parameters for selected cities

Station	Longitude (°E)	Latitude (°N)	Elevation (m)
Mosul	43.15	36.32	223
Baghdad	33.23	44.23	34
Rutba	33.03	40.28	615
Basra	30.57	47.78	2

Statistical methods were used for trend detection in the relative humidity time series. Linear regression and non-parametric test of Mann–Kendall were employed for trend detection in the time scales of monthly and annual. Linear

regression is a parametric test and it assumes that data has normal distribution and it evaluate existence of linear trend between time variable (X) and desire variable (Y). Slope of regression line is calculated by following equation [13]:

$$a = \bar{Y} - b\bar{X} \tag{1}$$

$$b = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sum_{i=1}^n (X_i - \bar{X})^2} \tag{2}$$

A single variable statistics of Mann–Kendall is defined for a special time series ($Z_k, k=1,2,\dots,n$) by following relation:

$$T = \sum_{j<i} \text{sgn}(Z_i - Z_j) \tag{3}$$

$$\text{sgn}(x) = \begin{cases} 1, & \text{if } x > 0 \\ 0, & \text{if } x = 0 \\ -1, & \text{if } x < 0 \end{cases} \tag{4}$$

If there is no any relationship between variables and the series has no trend, thus It would have [2]:

$$E(T) = 0 \tag{5}$$

and

$$\text{Var}(T) = n(n - 1)(2n + 5)/18 \tag{6}$$

Table II gives the degree of correlation and interpretation for the coefficients [14].

Table II: The degree of correlation and interpretation of the test coefficients

Coefficient	Correlation	Interpretation
Less than 0.2	Slight correlation	Almost no relationship
0.2 to 0.4	Low correlation	Small relationship
0.4 to 0.7	Moderate correlation	Substantial relationship
0.7 to 0.9	High correlation	Marked relationship
0.9 and above	Very high correlation	Solid relationship

III. RESULTS AND DISCUSSION

Figures 1 to 4 show the results of the linear regression analysis of the monthly mean surface relative humidity for Mosul, Baghdad, Rutba and Basra. It is seen that in general the relative humidity has a decreasing trends for the four cities during all months of the year. The results also indicate that during the summer months and the month of September trends are relatively small compared with those of the other months. This because summer the driest season in Iraq. Figure 5 illustrates the trend analysis of the annual mean of

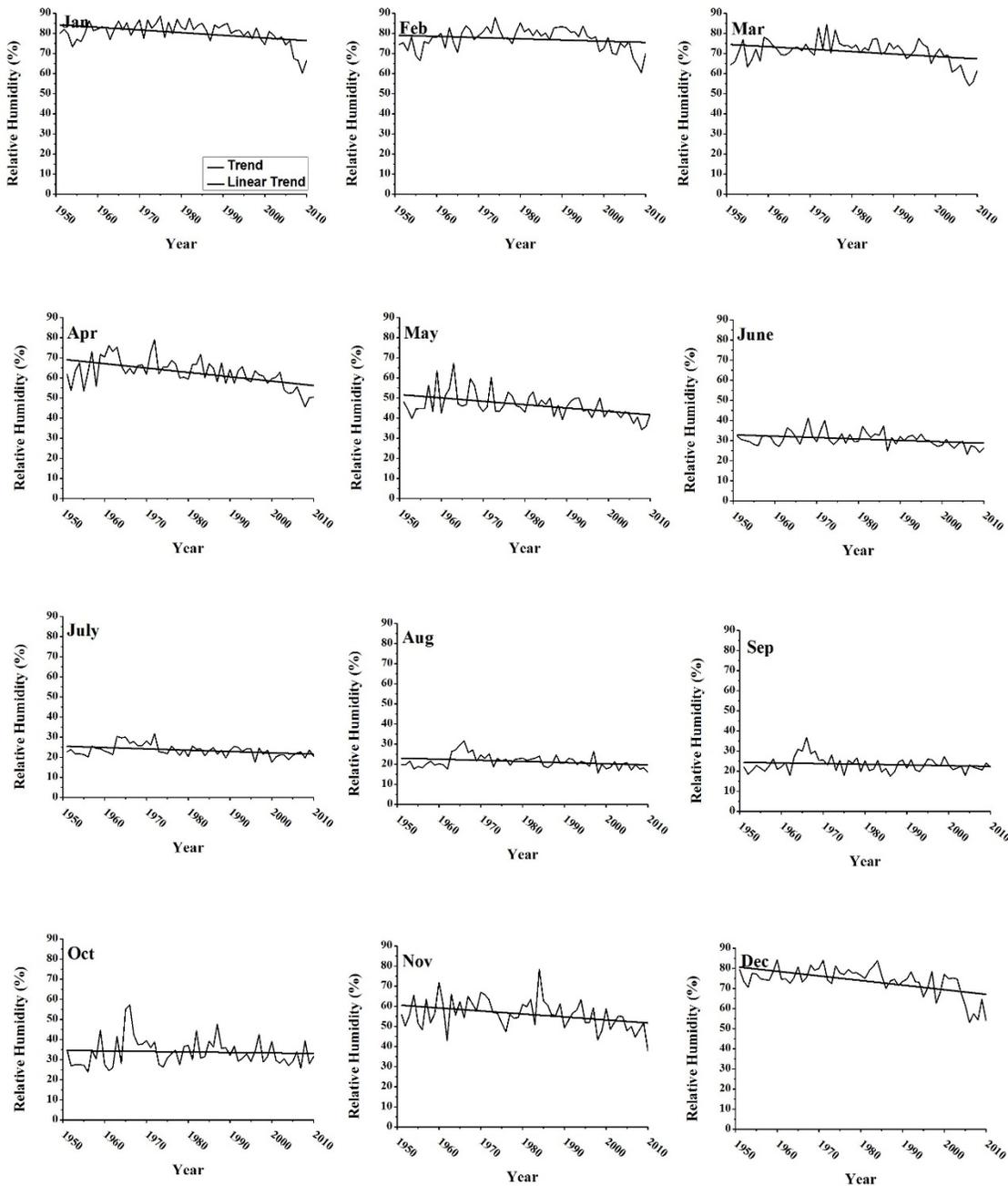


Figure 1: Time series of monthly relative humidity for Mosul city.

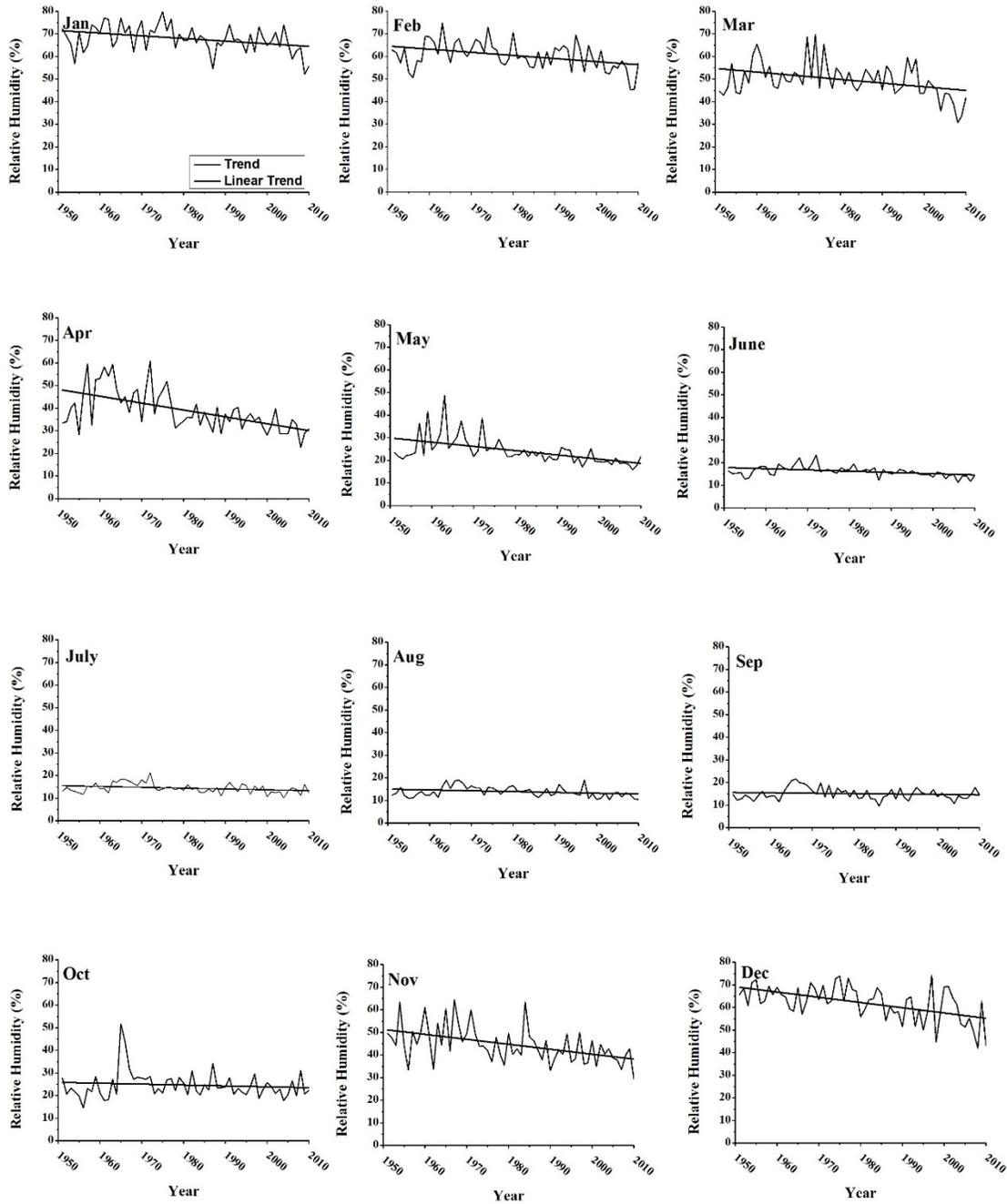


Figure 2: Time series of monthly relative humidity for Baghdad city.

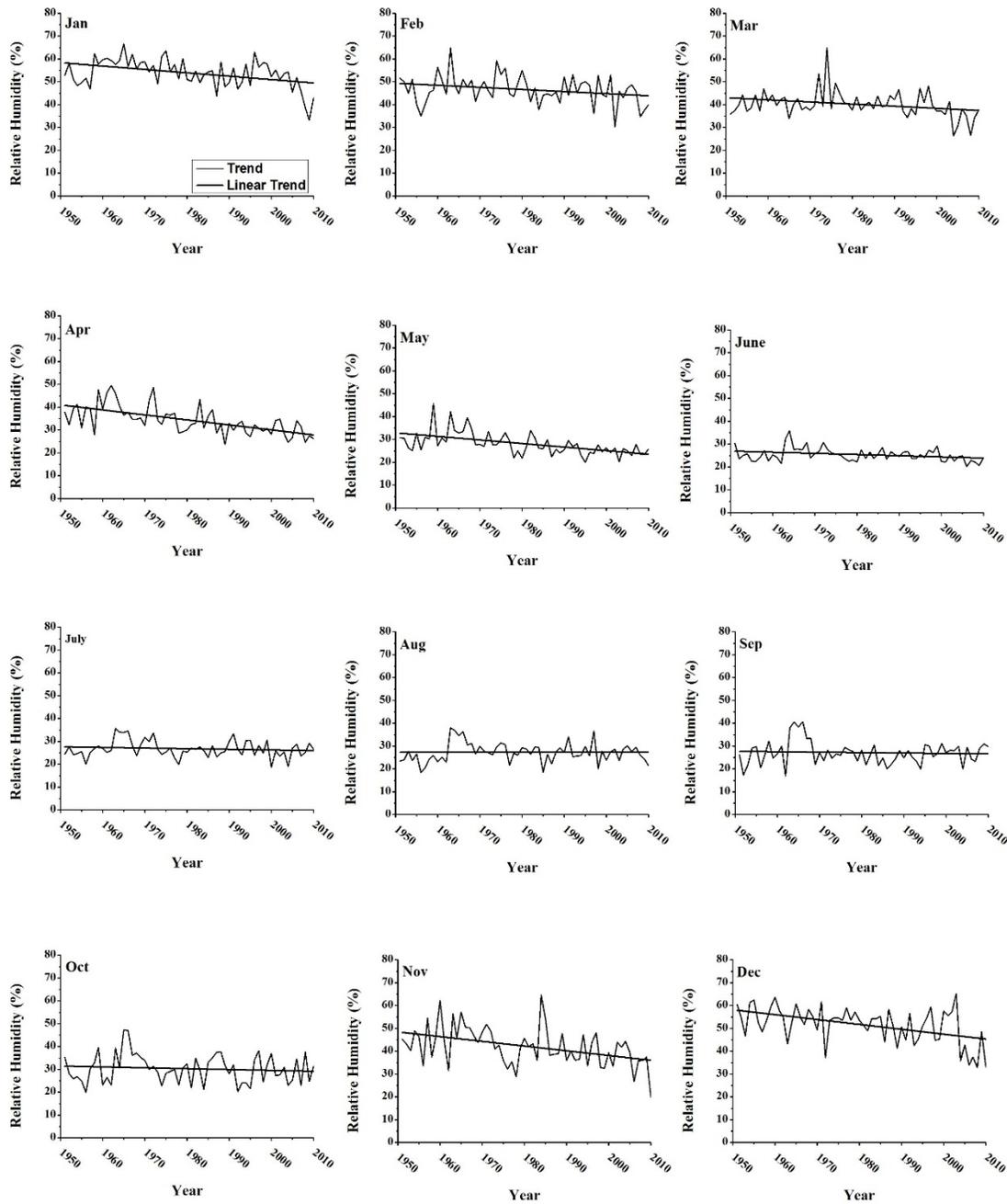


Figure 3: Time series of monthly relative humidity for Rutba city.

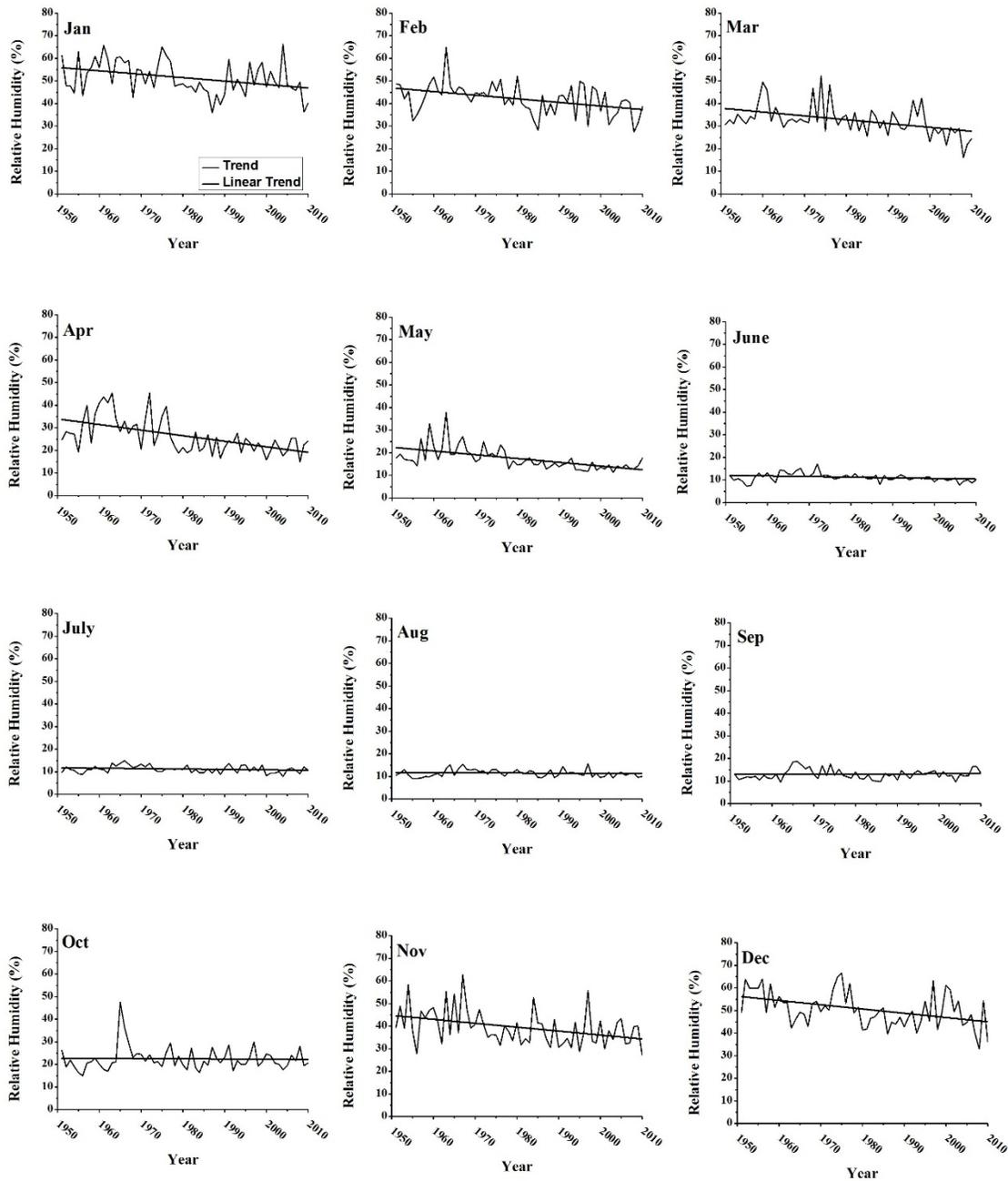


Figure 4: Time series of monthly relative humidity for Basra city.

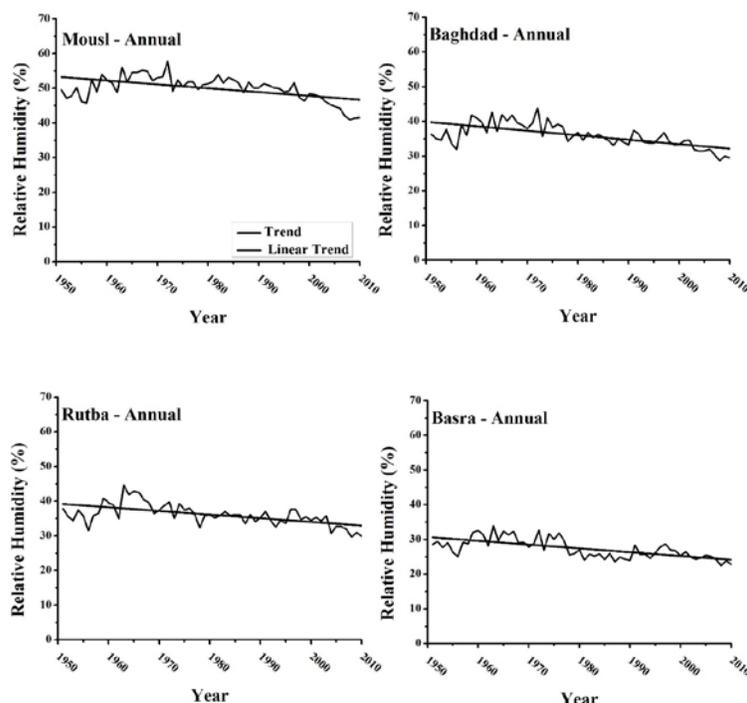


Figure 5: Annual time series of relative humidity for the four cities.

relative humidity for the four cities. It is clear that the annual relative humidity fluctuates around 50% for the northern city of Mosul and around 40% for central city of Baghdad and western city of Rutba, and around 30% for Basrah in the south. The most decreasing in annual relative humidity occurred in Mosul because of its relatively cooler climate. Table 3 summarizes the parameters of the linear regression equation for the four cities. It is seen that for Mosul and Baghdad the slope of the linear equation is negative for all months. For the Rutba, the linear trend is negative for all months except of August. Basra is characterize by negative linear trend for all months except for September and from the table its shown that the Annual linear trend is negative for all locations. Table 4 shows that the values of Mann–Kendall coefficient are comparable. It's evident that Mosul, and Baghdad stations are characterizes by negative trends for all months. Rutba station was characterize by negative trend for most of months except for the months of August and September, the coefficients are positive. Basra station was characterize by negative trend for most of months except for months of September and October, the trend was positive. The values of the correlation coefficients for Mosul, Baghdad and Basra stations are greater than 0.2 in most of months except for months of February, March, September and October for Mosul station, July, September and October for Baghdad station and July, August, September and October for Basra station the

correlation coefficients are less than 0.2. This low correlation suggests that there is small significant change in the relative humidity pattern over these regions. The statistical test for Rutba stations shows that the values of the correlation coefficients are less than 0.2 in most of months except for months of April, May, November and December the correlation coefficients are slightly greater than 0.2. This slight correlation suggests that there is no significant change in the relative humidity pattern over this region. The values of the correlation coefficients of Annual for the four cities greater than 0.3. This correlation suggests that there is substantial significant change in the annual relative humidity pattern over these regions.

I. CONCLUSION

Time series of monthly relative humidity were analysed for four cities in Iraq. Results indicated that relative humidity showed a notable decreasing trends during the most months of the year except the summer months. The summer season in Iraq is hot and dry and consequently small change in relative humidity from one year to another is expected. The northern part of Iraq was found to be the most part by the change in relative humidity. It is believed this reduction in relative humidity may be attributed to the global warming.

Table III: Monthly linear equations for selected cities

Station Month	Mosul		Baghdad		Rutba		Basra	
	b	a	b	a	b	a	b	a
January	-0.13305	343.6888	0.11734	300.2325	-0.14851	347.8971	-0.15164	351.6067
February	0.05984	195.6546	0.13799	333.6020	-0.09163	227.9923	-0.15972	358.2697
March	0.12126	310.9111	0.16265	371.8231	-0.09286	224.0285	-0.16955	368.4757
April	0.21721	492.7017	0.30415	641.3580	-0.21859	467.1606	-0.24667	514.847
May	0.16777	378.7556	0.18751	395.5032	-0.15577	336.5617	-0.16654	347.1210
June	0.07003	169.2945	0.05453	124.1369	-0.0511	126.5186	-0.02837	67.30762
July	0.06642	154.9927	0.03769	89.08258	-0.02781	81.79037	-0.01855	47.88465
August	0.05703	134.2585	0.03634	85.83149	0.00169	23.87473	-0.00946	30.16294
September	0.03403	90.7669	0.01792	50.48665	-0.0183	63.30938	0.00606	1.01263
October	0.02545	84.19389	0.03931	102.4252	-0.0377	104.8845	-0.00919	40.59931
November	0.14921	351.6010	0.21937	479.0263	-0.20689	451.8172	-0.17374	383.4941
December	0.22912	527.6115	0.23217	521.8132	-0.21412	475.6219	-0.18886	424.5643
Annual	0.11087	269.5359	0.12892	291.2767	-0.10513	244.2881	-0.10969	244.6121

Table IV: Results of Mann–Kendall test for selected cities

Station Month	Mosul	Baghdad	Rutba	Basra
January	-0.2528	-0.2432	-0.2713	-0.2588
February	-0.0696	-0.2645	-0.1675	-0.2812
March	-0.1911	-0.2488	-0.1901	-0.3249
April	-0.4057	-0.4206	-0.4659	-0.3828
May	-0.3359	-0.4724	-0.4109	-0.4848
June	-0.2444	-0.3779	-0.1998	-0.2761
July	-0.2627	-0.1993	-0.0493	-0.1317
August	-0.2073	-0.2045	0.0091	-0.0874
September	-0.0720	-0.0591	0.0040	0.0795
October	-0.0096	-0.0658	-0.0537	0.0357
November	-0.2598	-0.3540	-0.2975	-0.2620
December	-0.3327	-0.3425	-0.2935	-0.2964
Annual	-0.3962	-0.5130	-0.4439	-0.4775

ACKNOWLEDGMENT

The author acknowledge the use of data from the US National Center for Environmental Prediction.

REFERENCES

- [1] C. Souch, and C. S. B. Grimmond, "Applied climatology: 'heat waves,'" *Progress in Physical Geography*, 2004, 28, pp. 599-606.
- [2] R. Huth, and L. Pokorna, "Parametric versus nonparametric estimates of climatic trends," *Theor Appl Climato*, 2004, 77, pp. 107-112
- [3] J. Jaagus, "Climatic changes in Estonia during the second half of the 20th century in relationship with changes in large-scale atmospheric circulation," *Theor Appl Climato*, 2006, 83, pp. 77-88..
- [4] H. Feidas, H. Nouloupoulou, T. Makrogiannis, and T. Bora-Senta , "Trend analysis of precipitation time series in Greece and their relationship with circulation using surface and satellite data: 1955-2001, " *Theor Appl Climato*, 2007, 87, pp. 155-177.
- [5] Q. Zhang, C-Y Xu, Z. Zhang, and Y. D. Chen, "Changes of temperature extremes for 1960-2004 in Far-West China , " *Stoch Environ Res Risk Assess* 2009, 23(6), pp. 721-735.
- [6] X. Liu, Z. Xu, and R. Yu, "Trend of climate variability in China during the past decades, " *Climate Change*, 2011, 109, pp. 503-516.
- [7] H. Tabari, and M- B. Aghajamloo , "Temporal pattern of monthly aridity index in Iran with considering precipitation and evapotranspiration trends," *Int J Climatol*, 2012, 3, pp. 396-409.
- [8] D. J. Gaffen, and R. J. Ross, "Trends in relative humidity in Canada from 1953-2003," *J Climate*, 1999, 12, pp. 811-828.
- [9] Van Wijngaarden, and L. A. Vincent, "Trends in relative humidity in Canada from 1953-2003," Report prepared for Climate Research Barnchm Meteorological Service Canada, 2003.
- [10] J. S., Wright, A. Sobel, and J. Galeswsky, "Diagnosis of zonal mean relative humidity in a a warmer climate," *J Climate*, 2010, 23, pp. 4559-4569.
- [11] A. A. Abi-Taleb, A. J. Alawneh, and M. M. Smadi, "Statistical analysis of recent changes in relative humidity in Jordan," *Amer J Environ Sci*, 2007, 3(2), pp. 75-77.
- [12] K. Frimpong, J. Oosthuizen, and E. J. Van Etten, , "Recent trends in temperature and relative humidity in Bauku East. Northern Ghana," *J Geog and Geology*, 2014, 6, pp. 69-81.
- [13] B. Onoz, and M. Bayazit, "The power of statistical tests for trend detection," *Turkish J Eng Environ Sci*, 2003, 27, pp. 247-251.
- [14] F. Williams, *Reasoning with statistics, Reasoning with Statistics How to Read Quantitative Research*. 4th edition, Harcourt Brace Jovnovich College Publishers, Fort Worth, 1992.

AUTHORS

First Author – Abdulwahab H. Alobaidi, Department of Electronics, Institute of Technology, Middle Technical University, Baghdad, Iraq

Correspondence Author – Abdulwahab H. Alobaidi, PhD (Atmospheric Sciences), awhalobaidi@gmail.com

Evaluative Study of Internet Hate Groups and Role of Global Media

Dr. Ramesh Chandra Pathak

Assistant Professor, Journalism & Mass Communication, Banasthali University

Abstract- The Hate groups on internet are using internet to promote hate contents. Hate groups are using internet for their own sociological, business and political use. Their main aim is to spread hatred message. It has been often seen that internet hate groups are operating across the world and mostly used in the field of social media. The main objective of this research is to do evaluative study of Internet hate groups and to find out the role of global media in possible solution. At present we have powerful global media and they can pay attention towards this global crisis which is mainly based on racism, hate speech, hate comments, hate internet status and hate ideologies. There may be some possible link between the viewing of hate sites and hate crime. Terrorists and other extremists have taken advantage of Internet to promote their polluted agenda. Terrorist organizations like ISIS, Al-Qaida and others are using digital online media for spreading their hate monopolies. This research is an effort to examine comprehensive role of global media for stopping of the manipulation of Internet hate groups across the globe.

I. OBJECTIVES OF RESEARCH

To examine the role of Internet all over the world to engage in real-time conversations.

- To examine the role of Internet for hate groups in terms of promotion, recruitment and expanding their base to include younger audiences.
- To examine whether Internet hate group does have a part of a traditional faction.
- To examine whether online hate sites are explicitly antagonistic or violent.
- To examine whether online hate sites are appearing patriotic or benign.
- To examine whether online hate sites are contributed to the appeal of the group.
- To examine the purpose of hate groups websites.
- To examine whether Internet continues to grow, extremists find new ways to seek validation for their hateful agendas and to recruit members.
- To examine whether many so-called hate groups exist only in cyberspace.
- To examine activities of Internet Hateful intergroup conflict
- To examine behavior of Internet negative stereotypes.

II. IMPORTANCE OF RESEARCH

- This research will bring new facts about Internet hate groups.

- This research will bring any other designated online sector of society in context to several active internet hate groups.
- This research also advocates for future consequences about such types of online groups and their prospective threats to the world civilization.
- This research also trying to find out a suggestive definition of a "hate group" includes those having beliefs or practices that attack or malign an entire class of people, typically for their immutable characteristics.

III. HYPOTHESIS

It has been often seen that internet hate groups are operating across the world and mostly used in the field of social media. At present we have powerful global media and they can pay attention towards this global crisis which is mainly based on racism, hate speech, hate comments, hate internet status and hate ideologies. There may be possibilities to examine role of global media for preventing hate groups across the globe for doing evil business. There are also possibilities of cross examination of role of mainstream media, traditional media as well as social media for online internet hate groups. There may be possibilities that Internet brought new global exposure to many organizations including groups such as white supremacy and Islam phobia and several internet hate groups are operating websites dedicated to attacking their perceived enemies.

IV. REVIEW OF LITERATURE

The hate groups are mostly using online media, websites and internet. So, the evaluative study of internet hate groups and role of global media is mostly depends on the online and offline websites and web contents used by hate groups and different extremist groups. The related literatures written by different scholars are also part of review of literature. Different related magazines and related journals are part of review of literature.

V. RESEARCH ANALYSIS AND DISCUSSIONS

There are many active hate groups in the world among them several hate groups are operating their own hate websites via internet. Hate group under the category "black separatist" operating several hate websites "race of devils". Traditional Muslim online groups, does not accept white members and it is not regarded as a legitimate branch of Islam by mainstream Muslims.

Hate groups vocalize their beliefs and they act on their beliefs. Factors that contribute is the vulnerability of its members. Some factors are also associated with symbols and mythologies. Several websites are operating in a pattern that it usually separating hardcore haters from rhetorical haters. Therefore, hate websites are seen as a prerequisite of hate crimes. Sometimes hate websites became a vital condition of their possibility. Some listed groups operating online portals have been criticized by some political observers and prominent celebrities.

Their activities include criminal acts, marches, rallies, speeches, meetings, leafleting or publishing. Hate groups always advocates or engages in violence or other criminal activity. Therefore, keeping an eye on the Radical Right is very much necessary.

There are several groups which are operating hate websites to spread hate messages across the globe. Types of hate groups may be classified on the basis of several factors which includes Anti-immigrant, Anti-Muslim, Black separatist, Christian Identity, General hate, Holocaust denial, Ku Klux Klan, Neo-Confederate, Neo-Nazi, Racist skinheads, Radical traditional Catholicism, White nationalist, White Power music. Anti-immigrant online groups are described as xenophobic, publishing racist propaganda, and confronting or harassing immigrants and their supporters. Anti-Muslim hate groups are also operating online portals and may be described as disputing Islam's status as a respectable religion, and depicting Muslims as irrational, intolerant and violent and sanctioning pedophilia, marital rape and child marriage. Anti-LGBT website groups or anti-gay website groups can refer to activities against LGBT people, violence against LGBT people, LGBT rights opposition and religious opposition to homosexuality. Hate group under the category "black separatist" operating several hate websites "race of devils". Black separatism demands to create separate homeland. This is the general perception among black separatists that black people cannot grow in white dominated society.

White power musical websites also promotes white nationalism and expresses racism against non-whites. Radical traditionalist Catholics are also subscribe to an ideology that is rejected by the Vatican. Anti-Defamation League, groups such as white power skinheads with a particular focus on opposing non-white immigration are also operating hate websites. Neo-Confederacy websites usually follows hate comments against leaders, soldiers, writers, symbols and others. The current manifestation is splintered into several chapters and is classified as a hate group. There are many organizations worldwide which have advocated white supremacy, white nationalism, and anti-immigration. Neo-Nazism groups are also operating online hate portals that borrows elements from Nazi doctrine, including militant nationalism and fascism. Several holocaust deniers across the world are generally using internet for spread of hate messages. They generally use the term historical revisionism for their monopoly. Christian Identity is also an issue for certain groups who are affiliated believers of churches with an aggressive online campaign for their religious faith with an ideology of racist interpretation of Christianity. Further the list of websites may be classified on the basis of their activities and chapters which are as follows:

- 186 separate Ku Klux Klan (KKK) groups with 52 websites
- 196 neo-Nazi groups with 89 websites

- 111 white nationalist groups with 190 websites
- 98 white power skinhead groups with 25 websites
- 39 Christian Identity groups with 37 websites
- 93 neo-Confederate groups with 25 websites
- 113 black separatist groups with 40 websites
- Anti-gay, Holocaust denial, racist music, radical traditionalist Catholic and others with 172 hate websites.
- <http://stop-the-hate.org/neo-nazi.html>
- www.hatewatch.org
- www.stormfront.org
- http://www.adl.org/frames/front_explosion_of_hate.html
- http://www.adl.org/poisoning_web/about_net.html
- <http://www.reseau-medias.ca/eng/issues/internet/resource/recomend.html>,
- [SaveCalifornia.com](http://www.savecalifornia.com)
- [Islamthreat.com](http://www.islamthreat.com)
- [carolynyeager.net](http://www.carolynyeager.net)

Hate group can identify and deconstruct personal insecurities. Who are the most susceptible, especially children and youth, in developing a humanized understanding of out-groups and a positive self-esteem. Young people are attracted towards websites because they spend more time than any other group browsing on the internet. Hate websites target youths for convincing their ideology. Race has organized many societies. Several countries have undertaken initiatives to protect all "racial" groups. Racism is still a problem. The internet is the simplest tool to propagate racist views in new and possibly more efficient ways.

VI. ROLE OF GLOBAL MEDIA

Global media can spread powerful message about online hate groups. There should be awareness about different racial, extremist and ultras in mass media and media can aware people and society for reforms. Media can telecast a series of comprehensive package up on this burning issue. Mass Media especially mainstream media can telecast the comprehensive list of several hate groups which are operating hate websites to spread hate messages across the globe. Global media can pay attention through some social welfare messages up on the burning hate issues like Anti-immigrant, Anti-Muslim, Black separatist, Christian Identity, General hate, Holocaust denial, Ku Klux Klan, Neo-Confederate, Neo-Nazi, Racist skinheads, Radical traditional Catholicism, White nationalist, White Power music. The big news channels like CNN, Fox News, BBC News Service can attract the attention of global leaders, social reformers, NGO's, different political parties, youths and specially among teenagers which are frequently using online media, social networking sites and hate websites.

VII. THE RESULTS

Hate groups are using internet for their own manipulated interests. Internet is now powerful tool for spreading hate contents. Internet hate groups are mostly active on social media. Global media can pay attention towards this global crisis which

is mainly based on racism, hate speech, hate comments, hate internet status and hate ideologies. Terrorists, moist and other extremists have taken advantage of Internet to promote their polluted agenda. Global media can pay attention through some social welfare messages up on the hate issues like Anti-immigrant, Anti-Muslim and Black separatist, The global media can play comprehensive role in stopping manipulation of Internet hate groups across the globe.

VIII. RECOMMENDATIONS

- 1.Hate websites promoting General hate, Holocaust denial, Ku Klux Klan, Neo-Confederate, Neo-Nazi, Racist skinheads and Radical traditional Catholicism should be banned.
- 2.The big news channels like CNN, Fox News, BBC News Service can attract the attention of global leaders, social reformers, NGO's, different political parties, youths and specially among teenagers which are frequently using online media, social networking sites and hate websites.
- 3.Mass Media especially mainstream media can telecast the comprehensive list of several hate groups which are operating hate websites to spread hate messages across the globe.

REFERENCES

- [1] Denning, Dorothy E., and Peter J. Denning. *Internet Besieged: Countering Cyberspace Scofflaws*. New York: ACM Press (1998)

- [2] Perry, Barbara - 'Button-Down Terror': The Metamorphosis of the Hate Movement. *Sociological Focus* Vol. 33 (No. 2, May 2000): 113.
- [3] Schafer, John R. MA & Navarro. Joe, MA . The seven-stage hate model: The psychopathology of hate groups. *FBI Law Enforcement Bulletin*, March 2003
- [4] J. Wayne Dudley, "Hate" Organizations of the 1940s: The Columbians, Inc., *Phylon*, Vol. 42, No. 3 (3rd Qtr., 1981), pp. 262-274 (JSTOR)
- [5] Jessup, Michael *The Sword of Truth in the Sea of Lies: The Theology of Hate*, Google Print, p.165-p.166, in Robert J. Priest, Alvaro L. Nieves (ed.), *This Side of Heaven*, Oxford University Press US, 2006, ISBN 0-19-531056-X
- [6] Moody, M., "New Media-Same Stereotypes: An Analysis of Social Media Depictions of President Barack Obama and Michelle Obama", *The Journal of New Media & Culture*(2012).
- [7] Halevy, N.; Weisel, O.; Bornstein, G. (2012). "'In-group love" and "out-group hate" in repeated interaction between groups". *Journal of behavioral decision making* 25: 188-195.doi:10.1002/bdm.726
- [8] "Hate Crime Data Collection Guidelines", *Uniform Crime Reporting: Summary Reporting System: National Incident-Based Reporting System*, U.S. Department of Justice: Federal Bureau of Investigation, Criminal Justice Information Services Division, Revised October 1999.
- [9] Jessup, Michael "The Sword of Truth in the Sea of Lies: The Theology of Hate", in Priest, Robert J. and Alvaro L. Nieves, eds., *This Side of Heaven* (Oxford University Press US, 2006) ISBN 0-19-531056-X, Google Print, pp. 165-66
- [10] http://en.wikipedia.org/wiki/Hate_group
- [11] http://en.wikipedia.org/wiki/List_of_organizations_designated_by_the_Southern_Poverty_Law_Center_as_hate_groups

AUTHORS

First Author – Dr. Ramesh Chandra Pathak, Assistant Professor, Journalism & Mass Communication, Banasthali University, Rajasthan – 304022, India, Phone: 7073252751, E-mail : rcp.cmp@gmail.com

Synthesis, characterization and antitumour activity of Copper (II) complexes of some phosphonates

Ahmed I. Hanafy^{ab}, Omar M. Ali^{cd}, Zeinhom M. El-Bahy^{ab} and Mohamed Mohamed Soliman^{ce}

^a Chemistry Department, Faculty of Science, Taif University, Taif, Saudi Arabia.

^b Chemistry Department Faculty of Science Al-Azhar University, Cairo Egypt.

^c Medical Laboratory Department, Faculty of Applied Medical Sciences, Turabah, Taif University, Saudi Arabia

^d Chemistry Department, Faculty of Science, Menoufia University, Shebin El-Koam, Egypt

^e Biochemistry Department, Faculty of Veterinary Medicine, Benha University, Egypt

Abstract- Copper (II) complexes of three phosphonate ligands were prepared and fully characterized by elemental analysis, spectral and thermal studies. The IR spectral data showed that the phosphonate compounds behave as bidentate ligands coordinating to the copper ion through the P=O and NH groups. The electronic spectroscopic data support a distorted octahedral geometry around copper ion. The activity of the phosphonate ligands and their copper (II) complexes as small molecules were investigated towards DNA cleavage. The phosphonate ligands showed no activity, while the copper complexes showed DNA cleavage. The copper (II) complex of Diphenyl (3-hydroxyphenylamino)(2-hydroxyphenyl)methylphosphonate showed the highest activity towards DNA cleavage.

Index Terms- phosphonate; spectroscopic studies; DNA cleavage; antitumor.

I. INTRODUCTION

Cancer and tumoral malignancies remain among the most widespread and difficult to treat diseases. Despite tremendous efforts to improve therapy, the spectrum of available effective drugs is comparably limited and there is a considerable need for the development of new drugs and treatment alternatives. The first step in metastasis is tumor cell invasion, involving penetration of the basement membranes by tumor cells that can locally initiate a proteolytic cascade. Metastasis of a primary tumor to vital organs is the dominant cause of cancer related deaths.[1] Tumor cell invasion is a complex process involving cell adhesion, motility (migration) and the degradation of tissue and extracellular matrix (ECM) barriers by different proteases secreted by tumor cells. Invasive malignant cells are able to degrade the extracellular matrix and basement membranes, presumably through the secretion of proteolytic enzymes, including matrix metalloproteinases (MMPs), urokinase-type plasminogen activator (uPA).

Metal complexes constitute an important class of compounds endowed with biological interest. This type of compounds is widely used in medicine as a contrast agent in image magnetic resonance (MRI), in radiopharmaceuticals, in the treatment of arthritis, ulcers and in cancer chemotherapy [2–6]. In recent years, many researches [7,8] have focused on interaction of small molecules with DNA. DNA is generally the primary intracellular target of anticancer drugs, so the interaction between small molecules and DNA can cause DNA damage in cancer cells,

blocking the division of cancer cells, and resulting in cell death [9,10]. Among the metal ions regarded as coordination centers of potential anticancer agents, platinum and ruthenium ions are the most widely investigated up to now [11,12]. However, there is a growing interest in the synthesis of cheaper first-row transition metal complexes as efficient DNA binders with potential cytotoxic activity [13,14].

Phosphonates represent an important class of organophosphorus compounds. Their use in a variety of applications is well documented and their importance in a range of fields is increasing. Phosphonates have a lot of industrial applications as effective chelating agents, corrosion inhibitors in cooling systems [15-17] and water softeners[18]. They also used as stabilizers in oxidation processes associated with the pulp, paper, and textile industries [19]. In addition, The phosphonate functionality has been incorporated into a range of clinically useful drugs. Acyclic nucleoside phosphonates have shown potential as therapeutics for pathogenic species [20], and HIV protease inhibitors [21]. phosphonate containing protease inhibitors also have shown great potential for the treatment of Hepatitis C virus [22]. some have shown potential as cancer therapies [23] to inhibit growth of malignant cell lines [24,25] and also as anti-parasitic agents. [26,27].

In this study, small phosphonate molecules were prepared and characterized. The copper (II) complexes of the phosphonate ligands were also prepared and fully characterized. The ability of the phosphonates and their copper (II) complexes to cleave the DNA were investigated.

II. EXPERIMENTAL SECTION

2.1. Materials.

Perchloric acid, benzaldehyde, acetaldehyde, aniline, 2-nitroaniline and 3-hydroxyaniline were purchased from Sigma-Aldrich Chemical Co.

2.2. Synthesis of phosphonate ligands

2.2.1. Diphenyl (2-nitrophenylamino) (phenyl)methylphosphonate (DNPP)

HClO₄ (0.201 g, 2 mmol) was added to a solution of the benzaldehyde (1.06g, 0.01 mol) and aniline (0.93 g, 0.01 mol) in acetonitrile. The mixture was stirred for 15 min and then triphenyl phosphite (3.1 g, 0.01 mol) was added. After completion of the reaction (6 h), the reaction mixture was quenched with aq. saturated NaHCO₃ followed by brine solution

and then extracted with CH_2Cl_2 , dried over Na_2SO_4 , and concentrated under vacuum. The crude mixture was purified by washing with mixture of ether and pet. ether to afford the product.

2.2.2. Diphenyl (2-nitrophenylamino)(2-hydroxyphenyl) methylphosphonate (DNHP) and Diphenyl (3-hydroxyphenylamino)(2-hydroxyphenyl) methylphosphonate (DHHP)

HClO_4 (2 mmol) was added to a solution of the salicylaldehyde (0.01 mol) and 2-nitroaniline or 3-hydroxyaniline (0.01 mol) in acetonitrile. The mixture was stirred for 15 min and then triphenyl phosphite (3.1 g, 0.01 mol) was added. After completion of the reaction (6 h), the reaction mixture was quenched with aq. saturated NaHCO_3 followed by brine solution and then extracted with CH_2Cl_2 , dried over Na_2SO_4 , and concentrated under vacuum. The crude mixture was purified by washing with mixture of ether and pet. ether to afford the product.

2.3. Synthesis of metal complexes

Copper (II) chloride (0.01 mole) dissolved in about 50 ml absolute ethanol was added to the ethanolic solution of the selected ligand (0.01 mole). Small amount of solid sodium acetate was added to the solution with heating and contentious stirring. The precipitate was obtained, filtered off and washed many times with ethanol and then dried in an oven at 80°C .

2.4. Physical methods

Carbon, hydrogen and nitrogen contents were determined at the microanalytical unit, Cairo University, Egypt. IR spectra of the ligand and its solid complex were measured in KBr on a Mattson 5000 FTIR spectrometer. The electronic spectra were performed using Varian Cary 4 Bio UV/VIS spectrophotometer. ^1H - NMR spectrum of the ligand was recorded on Joel-90Q Fourier Transform (200 MHz) spectrometers in $[\text{D}_6]$ DMSO. The mass spectra of the phosphonate ligands were recorded on a Shimadzu GC-S-QP 1000 EX spectrometer using a direct inlet system. Thermal analysis measurement (TGA) was recorded on a

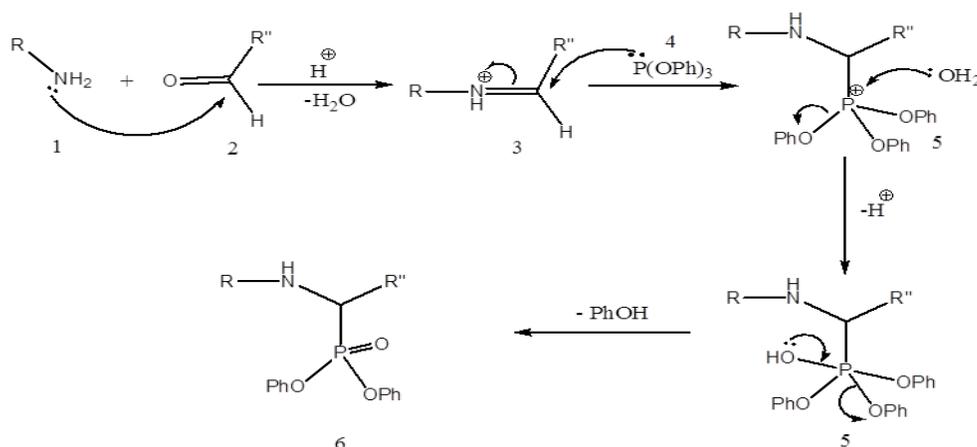
Shimadzu thermo-gravimetric analyzer model TGA-50 H, using 20 mg sample. The flow rate of nitrogen gas and heating rate were $20\text{ cm}^3\text{ min}^{-1}$ and $10^\circ\text{C min}^{-1}$, respectively. The magnetic susceptibility measurements for the copper (II) complexes were determined by the Gouy balance using $\text{Hg}[\text{Co}(\text{NCS})_4]$ as a calibrant at room temperature.

2.5. Nuclease-like activity assay (DNA cleavage)

Genomic DNA extracted from mammalian blood by salting out method was used to examine the DNA cleavage activity of examined ligands and their copper (II) complexes. DNA purity and concentration were examined spectrophotometrically at 260/280 nm. The cleavage reactions were carried out in a total volume of 15 μl containing 5 μl genomic DNA, 5 μl of ligand or complex in the range of (1.0 nM to 1mM), and 5 μl TE buffer (25.0 mM Tris-HCl containing of 50.0 mM NaCl pH 7.2). Genomic DNA alone or genomic DNA in the buffer was used as a control. The reactions were carried out at 37°C at different time intervals (0, 0.5, 1, 2, 6, 12 hours). A solution of loading dye (0.05% bromophenol blue, 5% glycerol, and 2 mM EDTA) was added to the reactions mixtures prior to running the gel. Dose dependent and time dependent experiments were carried out for each ligand and its complex used in this study. The prepared compounds were run on 1.0% agarose slab gel at a constant voltage of 100 V for 30 min in TBE (Tris- Borate-EDTA) buffer. Gels were stained with ethidium bromide and visualized under UV trans-illuminator (Syngene gel documentation system with digital camera).

III. RESULTS AND DISCUSSION

The phosphonate ligands were prepared by stirring the mixture of the aldehyde, amine and triphenyl phosphite as one-pot reaction as shown in scheme 1.



	L2	L3	L4
R	<i>O</i> -NO ₂ -Ph	<i>O</i> -NO ₂ -Ph	<i>m</i> -NO ₂ -Ph
R''	Phenyl	<i>O</i> -OH-Ph	<i>O</i> -OH-Ph

Scheme 1. The mechanism of the phosphonate preparation.

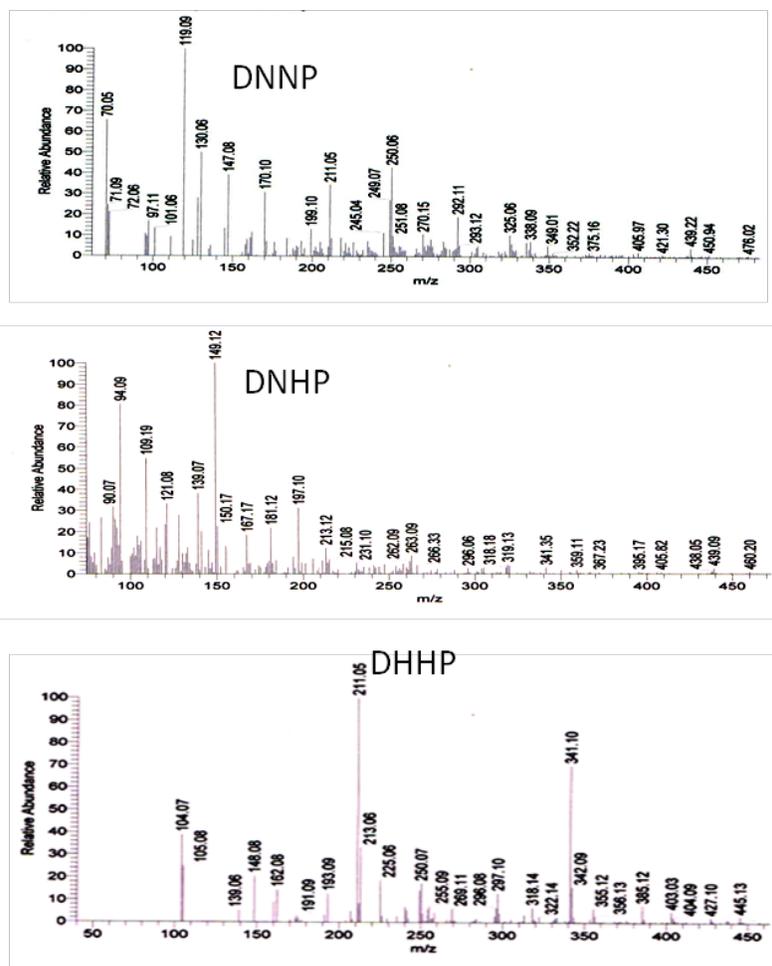


Figure 1. Mass spectrometry of the phosphonate ligands

3.1. IR spectra

IR spectral data of the organic ligands show bands at 3430 cm^{-1} in case of DNHP and DHHP attributed to νOH . The bands appear at $3008 - 3336\text{ cm}^{-1}$ are corresponding to νNH . The bands corresponding to $\nu\text{P=O}$ appear at $1214-1220\text{ cm}^{-1}$ [28]. The spectral data show bands at $1605-1680\text{ cm}^{-1}$ and $1413-1420\text{ cm}^{-1}$ 1440 cm^{-1} attributed to NH and OH bending, respectively. $^1\text{H-NMR}$ spectrum of DNHP shows $\delta = 4.66$ (d, 1H, CH), $6.64-7.78$ (m, 19H, Ar-H) and 9.33 (brs, 1H, NH). The bands at $\delta = 4.61$ (d, 1H, CH), 5.61 (brs, 1H, OH), $6.62-7.78$ (m, 18H, Ar-H) and 7.98 (brs, 1H, NH) are shown for DNHP. At the same time the $^1\text{H-NMR}$ spectrum of DHHP shows $\delta = 4.62$ (d, 1H, CH), 5.62 (brs, 2H, 2xOH), $6.60-7.68$ (m, 18H, Ar-H) and 7.99 (brs, 1H, NH). The molecular weights for the prepared ligands were determined by mass spectrometry (Figure1). The spectra show molecular ion peaks 460, 476 and 447 for DNHP, DNHP and DHHP, respectively. The IR and $^1\text{H-NMR}$ and mass spectral data

suggest the structure of the phosphonate ligands as shown in Figure 2.

IR spectra of the copper (II) complexes were recorded to confirm their structures. The vibrational mode assignments of the metal complexes were supported by comparison with the vibrational frequencies of the free ligands (Figure 3). By comparing the IR spectral data of the prepared ligands with their copper (II) complexes, it is found that the phosphonate ligands are coordinating with the copper ion by P=O oxygen and NH nitrogen atoms. This suggestion is supposed by shifting in the position of $\nu\text{P=O}$ band from $1214-1220\text{ cm}^{-1}$ in the ligands to $1243-1267\text{ cm}^{-1}$ in the copper (II) complexes. At the same time, the position of νNH band at the ligands which appear at $3008-3336\text{ cm}^{-1}$ in the phosphonate ligands are shifted to $3009-3460\text{ cm}^{-1}$. The binding with NH is supported by shifting in the position of NH bending from $1605-1670$ to $1617-1628\text{ cm}^{-1}$ in the copper (II) complexes.

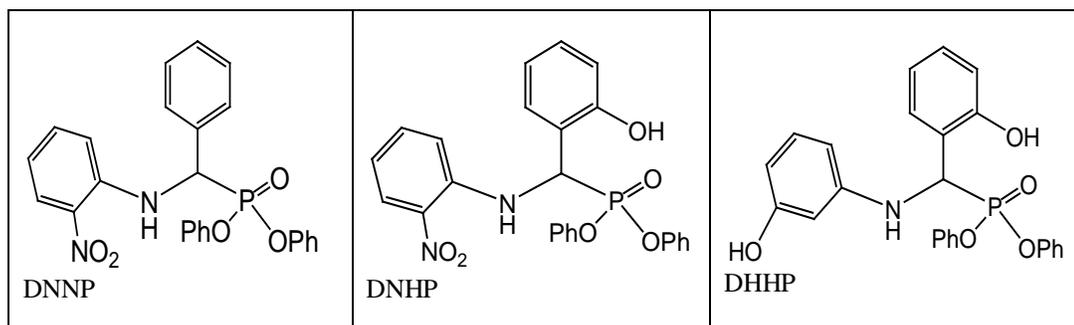


Figure 2. Structure of the phosphonate ligands

3.2. Electronic spectra

The electronic spectra of the copper complexes $\text{Cu}^{\text{II}}\text{DNNP}$, $\text{Cu}^{\text{II}}\text{DNHP}$ and $\text{Cu}^{\text{II}}\text{DHHP}$ (Figures 4) recorded at room temperature, in ethanol solution, show a broad band at ~ 695 nm. The copper(II) complexes with d^9 configuration are expected to experience Jahn-Teller distortion which leads to further splitting of the 2E_g and ${}^2T_{2g}$ levels. Moreover, they give rise to the ${}^2B_{1g} \rightarrow {}^2A_{1g}$ (ν_1), ${}^2B_{2g}$ (ν_2) and 2E_g (ν_3) transitions which are expected to be close in energy and generally appears as a broad band. Therefore the broad band centered at 695 nm is assigned to the envelope of ${}^2B_{1g} \rightarrow {}^2A_{1g}$, ${}^2B_{2g}$ and 2E_g transitions [29] which support (with the magnetic moment $=1.8-1.9$ BM) a distortion octahedral geometry around copper (II) in the complex.

3.3. Thermal analysis

The TGA analysis is commonly used to measure and confirm solvent inside and/or outside the coordination sphere and gives information about the stability of the compound. The thermogram of the three prepared complexes shows 3-4 stages of mass loss from 25-1000 $^{\circ}\text{C}$. The $\text{Cu}^{\text{II}}\text{DNNP}$ complex shows three inflection stages. The first stage at the temperature range of 43-125 $^{\circ}\text{C}$ with weight loss of (Calcd. 5.71%, found 5.78%) corresponding to two water molecules. The second stage in the temperature range of 230-330 $^{\circ}\text{C}$ with weight loss of (Calcd. 21.88%, found 22.19%) corresponding to PhNH_2NO_2 . The third stage in the temperature range of 746-984 $^{\circ}\text{C}$ with weight loss of (Calcd. 42.18 %, found 42.17%) corresponding to two molecules of PhOH and one molecule of Ph.

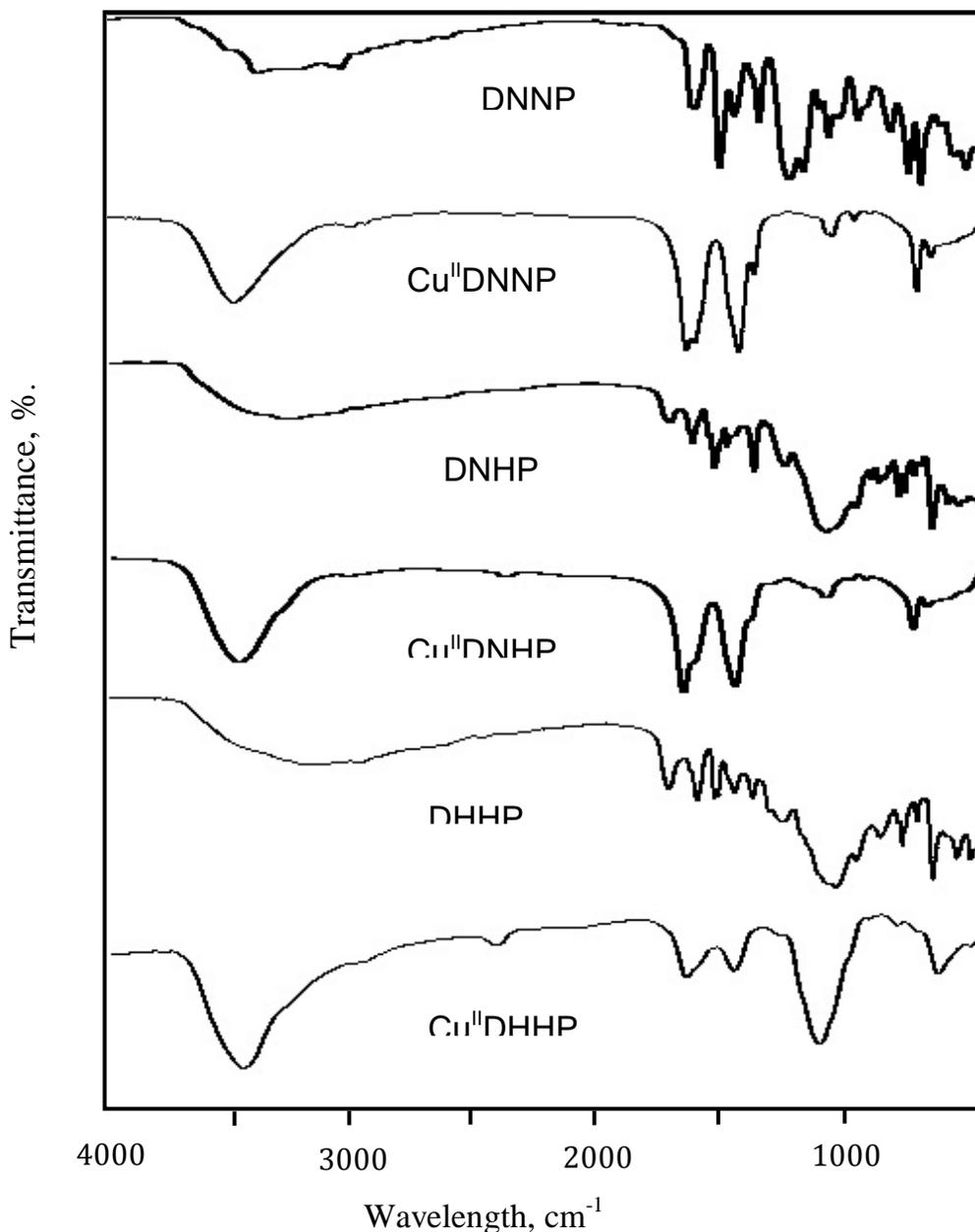


Figure 3. IR spectra of the ligands and their copper (II) complexes

The TGA of $\text{Cu}^{\text{II}}\text{DNHP}$ complex also shows three degradation stages. The first stage in the temperature range of 40-129 °C is assigned to removal of two water molecules (Calcd. 5.57%, found 5.70%). The second stage in the temperature range of 130-325 °C is assigned to removal of $\text{PhNO}_2\text{NH}_2\cdot\text{HCl}$ with weight loss of (Calcd. 26.91%, found 27.318%). The third stage in the temperature range of 715-1000 °C with weight loss of (Calcd. 24.13%, found 24.10%) is corresponding to removal of two molecules of PhOH . On the other hand the TGA of $\text{Cu}^{\text{II}}\text{DHHP}$ shows four degradation stages from 25- 1000 °C. The first stage in the temperature range of 43-125 °C corresponds to removal of two water molecules with weight loss (Calcd. 5.82%, found 5.79%). The second degradation stage in the temperature range of 150-270 °C is assigned to removal of NO_2 with weight

loss (Calcd. 7.44%, found 7.35%). The third stage with weight loss (Calcd. 15.05 %, found 14.59%) in the range of 352-511 °C corresponds to removal of PhNH_2 . The fourth stage in the temperature range of 680-914 °C with weight loss (Calcd. 25.26 %, found 25.52%) corresponds to removal of two Ph molecules. The total weight loss of the $\text{Cu}(\text{II})$ complexes $\text{Cu}^{\text{II}}\text{DNNP}$, $\text{Cu}^{\text{II}}\text{DNHP}$ and $\text{Cu}^{\text{II}}\text{DHHP}$ are 46.40, 42.90 and 30.24 % till 1000 °C. The weight remaining in case of $\text{Cu}(\text{II})$ complexes shows that $\text{Cu}^{\text{II}}\text{DHHP}$ is the most stable of the prepared complexes, then $\text{Cu}^{\text{II}}\text{DNHP}$ and finally $\text{Cu}^{\text{II}}\text{DNNP}$. The elemental analysis (Table 1) with the spectroscopic tools data suggest the structure of the copper (II) complexes; $\text{CuLCl}_2\cdot 2\text{H}_2\text{O}$ where L is DNNP, DNHP or DHHP as shown in Figure 5.

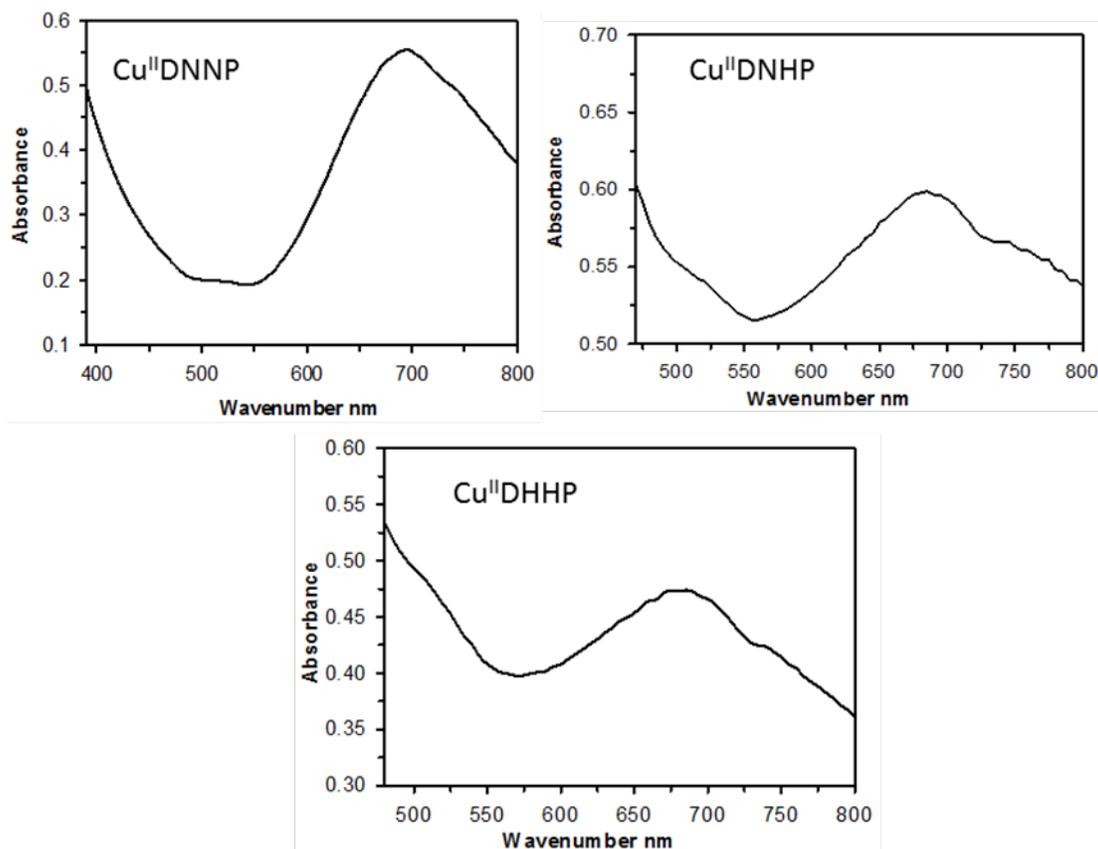


Figure 4. Electronic spectra of the copper (II) complexes

Table 1. Elemental analysis for all complexes.

Compound	M.wt.	C% calc. (Found)	H% calc. (Found)	N% calc. (Found)	Cu% calc. (Found)
Cu ^{II} NNP	630.62	47.57 (47.29)	3.96 (4.16)	4.44 (4.49)	10.07 (10.01)
Cu ^{II} NHP	646.61	46.39 (46.37)	3.86 (3.87)	4.33 (4.38)	9.82 (9.88)
Cu ^{II} HHP	617.62	48.57 (59.42)	4.21 (4.79)	2.27 (2.47)	10.28 (10.31)

3.4. Gel electrophoresis

Particular attention has been devoted to transition metal complexes endowed with planar aromatic side groups, which can bind with DNA by both metal ion coordination and intercalation of the aromatic moiety [30].

The effect of the organic ligands and their copper (II) complexes on DNA cleavage was studied by DNA migration in

agarose gel. The genome DNA was incubated for 24 h at 37 °C in the presence of the ligand or its copper complex with increasing concentrations. The samples were run in 1.0 % agarose gel in TBE (tris– Borate- EDTA) buffer of pH 7.4 at 2 V/cm for 30 min.

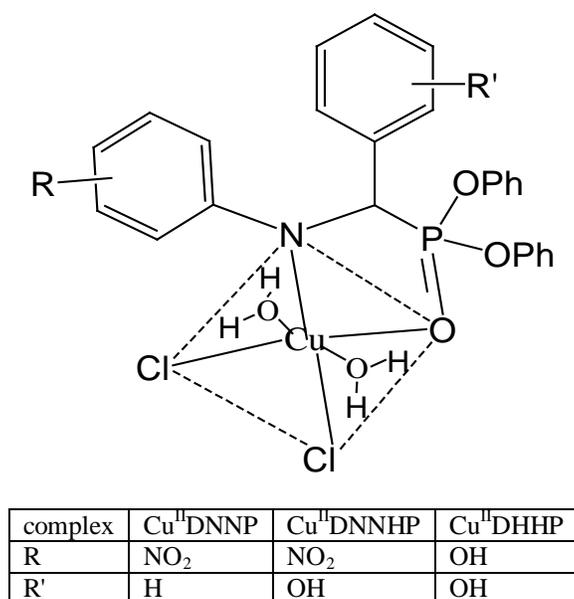


Figure 5. Structure of copper (II) complexes

The gel was stained with EtBr and photographs were taken in a syngene gel documentation system. As seen in Figure 6, the DNA migration as well as the intensity of the supercoiled DNA did not change in the presence of phosphonate ligands. Thus, suggest no cleavage activities were achieved for ligands towards DNA. On the other hand the migration and intensity of the DNA

bands were affected in the presence of Cu^{II}DNHP and Cu^{II}DHHP complexes (Figure 7). The disappearance of the supercoiled DNA in the presence of copper complexes together with the decreasing in the brightness of the DNA bands suggests the cleavage of the genome DNA.

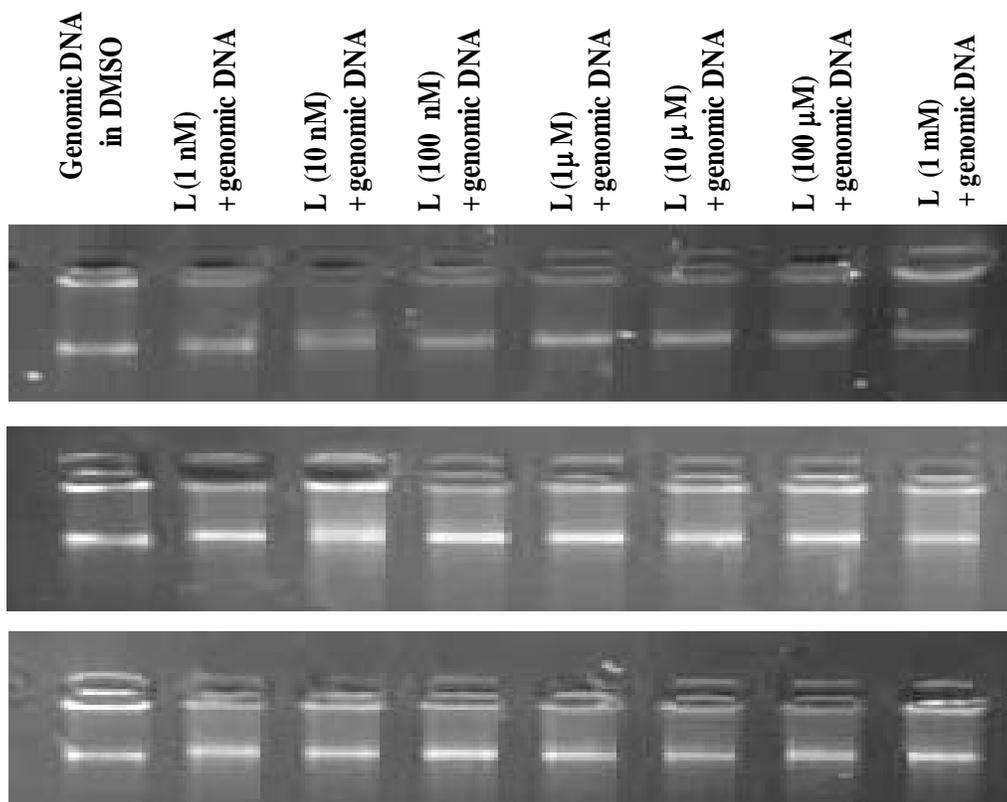


Figure 6. The DNA binding activity of the ligands where L = DNNP, DNHP and DNHHP from up to below. Various concentrations of the ligands were incubated with genomic DNA (100 ng) for 24 hours at 37 °C.

At the same time, the copper complex $\text{Cu}^{\text{II}}\text{DNHP}$ didn't show any activity towards the DNA binding. It was found that the more concentration of the copper (II) complex the more strongly cleavage effect on the genomic DNA. In order to study

the effect of time on the DNA binding, the copper (II) complexes were incubated with the genomic DNA for different time courses. It was found that the complex $\text{Cu}^{\text{II}}\text{DHHP}$ has the greatest ability to cleave the genomic DNA (Figure 8).

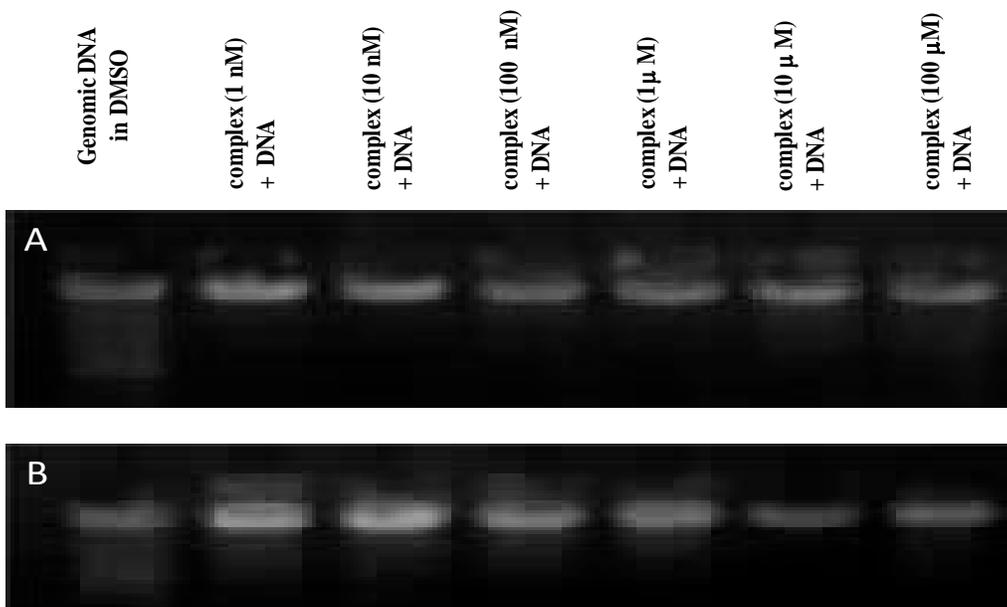


Figure 7. The DNA binding activity of $\text{Cu}^{\text{II}}\text{DNHP}$ (A) and $\text{Cu}^{\text{II}}\text{DNHHP}$ (B) complexes. Various concentrations of the complexes were incubated with genomic DNA (100 ng) for 24 hours at 37 °C. DNA.

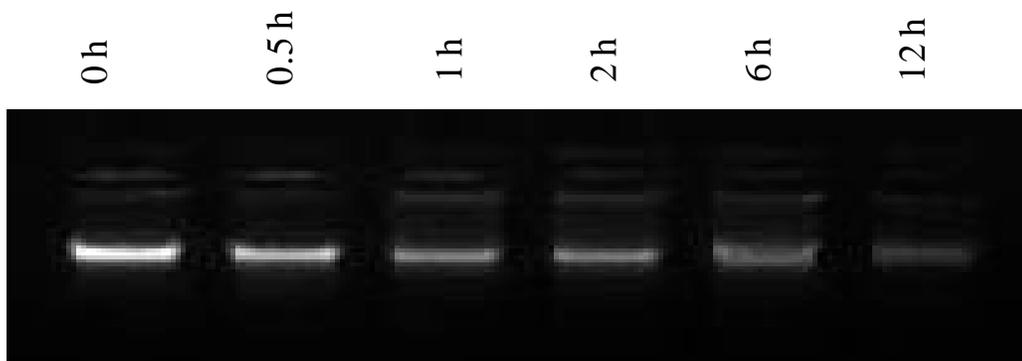


Figure 8. Time dependant effect of $\text{Cu}^{\text{II}}\text{DNHHP}$ complex on DNA binding activity. The complex (100 mM) was incubated with genomic DNA for different time intervals at 37 °C.

IV. CONCLUSION

Three phosphonate molecules were prepared and characterized by different physicochemical tools. The copper (II) complexes of these phosphonates were also synthesized and characterized. the mode of binding was studied and the thermal analysis of these complexes showed that the $\text{Cu}^{\text{II}}\text{DHHP}$ is the most stable complex of the all complexes under investigation. The anticancer activity of these complexes was investigated using DNA cleavage study and showed that $\text{Cu}^{\text{II}}\text{DHHP}$ reveal the highest ability to cleavage the genomic DNA.

ACKNOWLEDGMENTS

The authors acknowledge Taif University for supporting this work by Taif University research program (1-435-3162)

REFERENCES

- [1] L.A. Liotta, W.G.S. Stevenson, Semin. Cancer Biol., 1 (1990) 99.
- [2] C. Orvig, M.J. Abrams, Chem. Rev. 99 (1999) 2201.
- [3] S.P. Fricker, Metal Compounds in Cancer Therapy, Chapman & Hall, London, 1994.

- [4] T. Storr, K.H. Thompson, C. Orvig, *Chem. Soc. Rev.* 35 (2006) 534.
- [5] K.H. Thompson, C. Orvig, *Dalton Trans.* (2006) 761.
- [6] C.S. Allardyce, P.J. Dyson, in: G. Simonneaux (Ed.), *Bioorganometallic Chemistry*, Springer-Verlag, Berlin/ Heidelberg, (2006), p. 177.
- [7] Y.M. Song, Q. Wu, P.J. Yang, N.N. Luan, L.F. Wang, Y.M. Liu, *J. Inorg. Biochem.*, 100 (2006) 1685.
- [8] Tan, C.P.; Liu, J.; Chen, L.M.; Shi, S.; Ji, L.N.; *J. Inorg. Biochem.*, 102 (2008) 1644.
- [9] G. Zuber, Jr J.C. Quada, S.M. Hecht, *J. Am. Chem. Soc.*, 120 (1998) 9368.
- [10] S.M. Hecht, *J. Nat. Prod.*, 63 (2000) 158.
- [11] W. Han Ang, P.J. Dyson, *Eur. J. Inorg. Chem.* (2006) 4003.
- [12] N. Busto, J. Valladolid, C. Aliende, F.A. Jalón, B.R. Manzano, A.M. Rodríguez, J.F. Gaspar, C. Martins, T. Biver, G. Espino, J.M. Leal, B. García, *Chem. Asian J.*, 7 (2012) 788.
- [13] M.M. Al-Mogren, A.M.A. Alaghaz, A.E. Ebrahim, *Spectrochim. Acta A*, 114 (2013) 695.
- [14] K. Pothiraj, T. Baskaran, N. Raman, *J. Coord. Chem.*, 65 (2012) 2110.
- [15] E. G. Kontecka, J. Jezierska, M. Lecouvey, Y. Leroux, H. Kozłowski, *J. Inorg. Biochem.* 89 (2002) 13.
- [16] E.G. Kontecka, R. Silvagni, R. Lipinski, M. Lecouvey, F.C. Marincola, G. Crisponi, V.M. Nurchi, Y. Leroux, H. Kozłowski, *Inorg. Chim. Acta* 339 (2002) 111.
- [17] T. Bailly, R. Burgada, T. Prange, M. Lecouvey, *Tetrahedron Lett.* 44 (2003) 189.
- [18] H. Fleisch, *Der Othopäde* 36 (2007) 103.
- [19] B. Nowack, *Water Research* 37 (2003) 2533.
- [20] M.L. Bigsterbosch, L.J.J.W. Smeijsters, T. J. C. van Berkel, *Antimicrob. Agents Chemother.* 42 (1998) 1146.
- [21] S. V. Gulnik, M. Eissenstat, *Curr. Opin. HIV AIDS* 3 (2008) 633.
- [22] X. C. Sheng, H. Pyun, K. Chaudhary, J. Wang, E. Doerffler, M. Fleury, D. McMurtie, X. Chem, W.E. Delaney, C.U. Kim, *Biorg. Med. Chem. Lett.* 19 (2009) 3453.
- [23] T.A. Guise, *Cancer Treat. Rev.* 34 (2008) S19.
- [24] C.M. Shipman, M.J. Rogers, J.F. Apperley, R. Graham, G. Russe, P.I. B. Croucher, *J. Haematol.* 98 (1997) 665.
- [25] V. Kunzmann, E. Bauer, J. Feurle, F. Weissinger, H.P. Tony, M. Wilhelm, *Blood* 96 (2000) 384.
- [26] M.B. Martin, J.S. Grimley, J.C. Lewis, H.T. Heath, B.N. Bailey, H. Kendrick, V. Yardley, A. Caldera, R. Lira, J.A. Urbina, S.N. Moreno, R. Docampo, S.L. Croft, E. Oldfield, *J. Med. Chem.* 44 (2001) 909.
- [27] V. Yardley, A.A. Khan, M.B. Martin, T.R. Slifer, F.G. Aruajo, S.N. Moreno, R. Docampo, S.L. Croft, E. Oldfield, *Antimicrob. Agents Chemother.* 46 (2002) 929.
- [28] H. Doweidar, Y.M. Moustafa, K. El-Egili, I. Abbas, *Vib. Spectrosc.* 37 (2005) 91.
- [29] R. Li, B. Moubaraki, K.S. Murray, S. Brooker, *Dalton Trans.* (2008) 6014.
- [30] H.K. Liu, P.J. Sadler, *Acc. Chem. Res.* 44 (2011) 349.

AUTHORS

First Author – Ahmed I. Hanafy, Chemistry Department, Faculty of Science, Taif University, Taif, Saudi Arabia.

Second Author – Omar M. Ali, Medical Laboratory Department, Faculty of Applied Medical Sciences, Turabah, Taif University, Saudi Arabia

Third Author – Zeinhom M. El-Bahy, Chemistry Department Faculty of Science Al-Azhar University, Cairo Egypt

Fourth Author – Mohamed Mohamed Soliman, Biochemistry Department, Faculty of Veterinary Medicine, Benha University, Egypt

Analysis of Relative Humidity in Iraq for the Period 1951-2010

Abdulwahab H. Alobaidi

Department of Electronics, Institute of Technology, Middle Technical University, Baghdad, Iraq

Abstract- The analysis of trends in temperature, precipitation, and relative humidity and evaluating their statistical significance have recently received a great concern for the assessment climate change effects. This research is to analyze a long time record of surface relative humidity for four cities, representing different climate zones, in Iraq using NCEP data. Parametric linear regression and nonparametric Mann–Kendall tests were applied for detecting monthly and annual trends in the relative humidity. The monthly time series showed that relative humidity is decreasing during winter, spring and autumn months. The decreasing trend during summer months is relatively weaker. This because summer in Iraq is hot and dry so changes in relative humidity is small. The annual relative humidity also exhibited a decreasing trend for the four cities. The results also illustrated that the decreasing trend in relative humidity is relatively stronger for Mosul because of it rather cooler climate and relatively smaller for the southern city of Basrah.

Index Terms- Relative humidity, Time series, Mann-Kendall, Iraq

I. INTRODUCTION

The climate system of the Earth is ever changing across all space and time scales. Evidence for past changes arises from “proxies” such as ice cores and geological records, and for more recent times from tree rings, coral growth, and historical documentary records. Only over the last two Centuries the atmosphere have been actively measured. Since the late 18th Century, measurements by thermometers and other surface instruments on land have been available along with measurements made by ships. After the Second World War, balloon-based sounding of the free atmosphere began and finally, since the 1970s satellites have also been employed to monitor the climate system. To date, climate data record construction efforts have principally considered temperature and to a lesser extent pressure and precipitation. However, even taken together these are an incomplete diagnostic of the climate system and do not adequately constrain our understanding. Humidity, both relative and absolute, is potentially a very insightful tool for climate

research. In addition, humidity has important implications for Climate Impact studies including human heat stress [1].

Analyzing long-term trends in hydroclimatic parameters and assessing their statistical significance are fundamental tools in the detection of climate change [2]. Recently, many scientists with analyzing trends in hydroclimatic parameters attempted to clarify whether or not there is an obvious climate change [3][4][5][6][7]. Compared with the analysis of air temperature and precipitation records, a few studies have been carried out to examine the trends of relative humidity and dew point temperature searching for evidence of climate change. Gaffen and Ross (1999) [8] studied the trends of relative humidity and dew point temperature in the United States for the period 1951–1990. They found that relative humidity trends were weaker than specific humidity trends. van Wijngaarden and Vincent (2003) [9] assessed changes in relative humidity in Canada over the period 1953–2003 and found a substantial decrease in relative humidity throughout the country. Abu-Taleb et al. (2007) [10] examined recent changes in annual and seasonal relative humidity in Jordan. Their analysis showed an increasing trend in the relative humidity time series at different stations which were found to be statistically significant during summer and autumn seasons. Wright et al. (2010) [11] analyzed the zonal mean relative humidity changes in a warmer climate. They found that relative humidity changes near the extratropical tropopause and in the lower troposphere are largely dependent on changes in the distribution and gradients of temperature. Talee et al. (2012) [12] reported on observed changes in relative humidity and dew point temperature in coastal regions of Iran. Their results showed that annual relative humidity increased by 1.03 and 0.28% per decade while annual dew point temperature increased by 0.29 and 0.15°C per decade at the northern and southern regions, respectively. Frimpong et al. (2014) carried out an extensive analyses of trends in mean annual and mean seasonal minimum and maximum temperatures and relative humidity were examined for Bawku East, northern Ghana, for the period 1961 to 2012. They concluded that there declining trends in relative humidity were observed at 6 am and 3 pm at seasonal and annual levels at Binduri and Garu, while there was a rising trend in relative humidity at Manga. The aim of this work is to analyze long term records of relative humidity in Iraq. NCEP data for the period 1951-2010 were used for four stations located in the different climate zones of Iraq.

II. MATERIALS AND METHOD

In this research surface relative humidity data from the National Center for Environmental Prediction (NCEP) were used. Data are available for the period from 1951 to 2010.

Relative humidity data for four cities representing different climate zones in Iraq were analyzed. Table I gives the geographical coordinates of these cities.

Table I: The geographical parameters for selected cities

Station	Longitude (°E)	Latitude (°N)	Elevation (m)
Mosul	43.15	36.32	223
Baghdad	33.23	44.23	34
Rutba	33.03	40.28	615
Basra	30.57	47.78	2

Statistical methods were used for trend detection in the relative humidity time series. Linear regression and non-parametric test of Mann–Kendall were employed for trend detection in the time scales of monthly and annual. Linear

regression is a parametric test and it assumes that data has normal distribution and it evaluate existence of linear trend between time variable (X) and desire variable (Y). Slope of regression line is calculated by following equation [13]:

$$a = \bar{Y} - b\bar{X} \tag{1}$$

$$b = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sum_{i=1}^n (X_i - \bar{X})^2} \tag{2}$$

A single variable statistics of Mann–Kendall is defined for a special time series ($Z_k, k=1,2,\dots,n$) by following relation:

$$T = \sum_{j<i} \text{sgn}(Z_i - Z_j) \tag{3}$$

$$\text{sgn}(x) = \begin{cases} 1, \dots \text{if } \dots x > 0 \\ 0, \dots \text{if } \dots x = 0 \\ -1, \dots \text{if } \dots x < 0 \end{cases} \tag{4}$$

If there is no any relationship between variables and the series has no trend, thus It would have [2]:

$$E(T) = 0 \tag{5}$$

and

$$\text{Var}(T) = n(n - 1)(2n + 5)/18 \tag{6}$$

Table II gives the degree of correlation and interpretation for the coefficients [14].

Table II: The degree of correlation and interpretation of the test coefficients

Coefficient	Correlation	Interpretation
Less than 0.2	Slight correlation	Almost no relationship
0.2 to 0.4	Low correlation	Small relationship
0.4 to 0.7	Moderate correlation	Substantial relationship
0.7 to 0.9	High correlation	Marked relationship
0.9 and above	Very high correlation	Solid relationship

III. RESULTS AND DISCUSSION

Figures 1 to 4 show the results of the linear regression analysis of the monthly mean surface relative humidity for Mosul, Baghdad, Rutba and Basra. It is seen that in general the relative humidity has a decreasing trends for the four cities during all

months of the year. The results also indicate that during the summer months and the month of September trends are relatively small compared with those of the other months. This because summer the driest season in Iraq. Figure 5 illustrates the trend analysis of the annual mean of

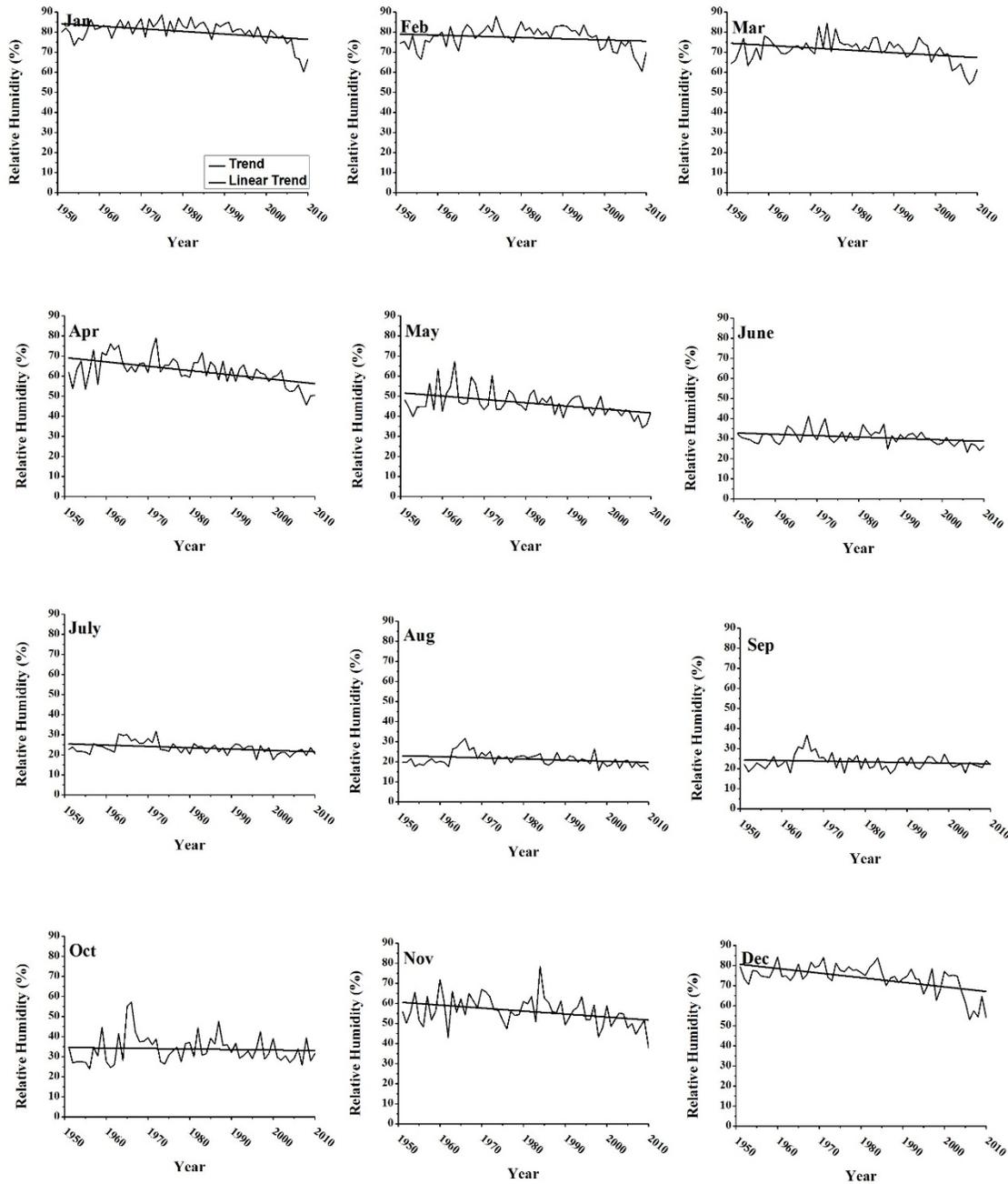


Figure 1: Time series of monthly relative humidity for Mosul city.

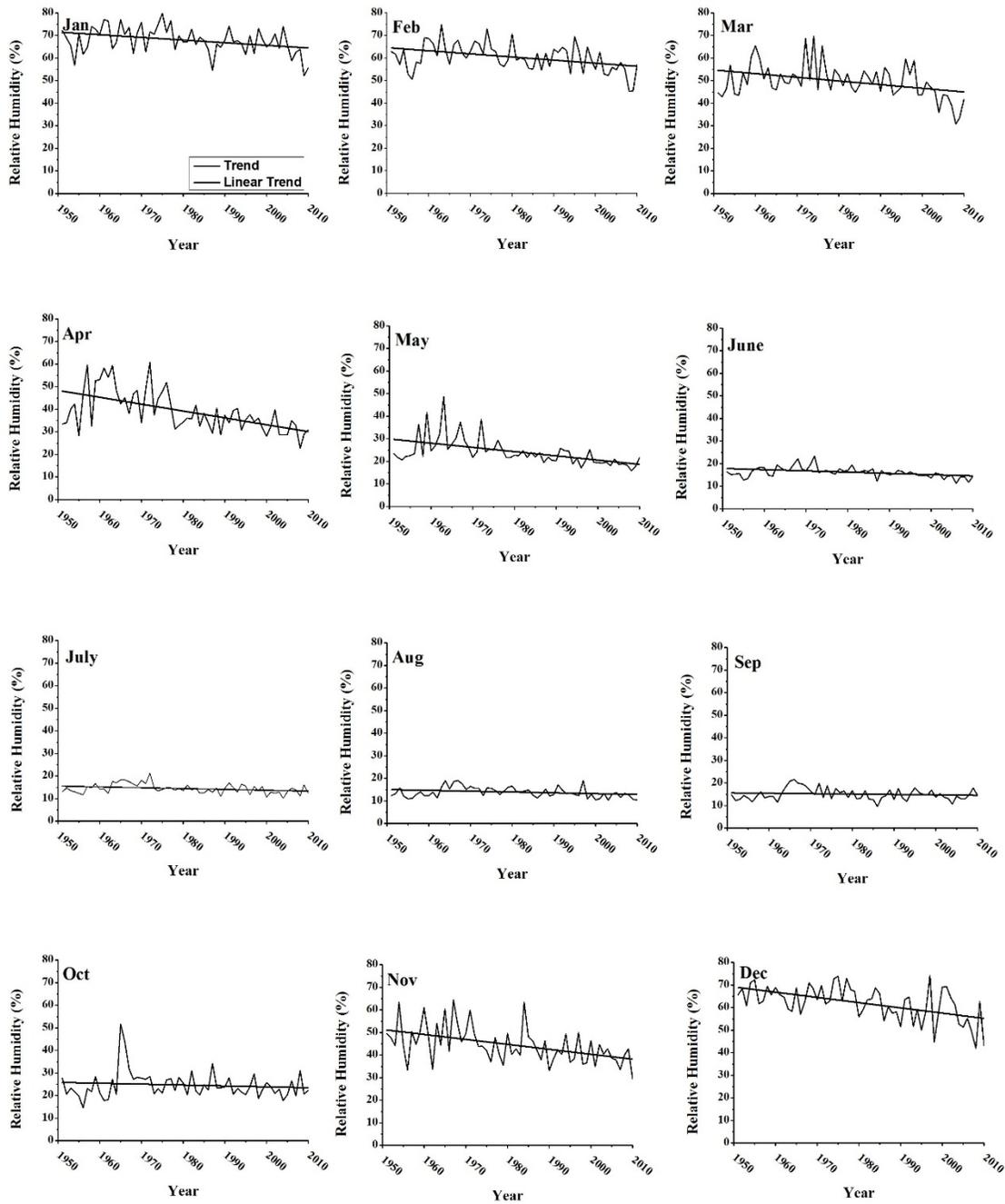


Figure 2: Time series of monthly relative humidity for Baghdad city.

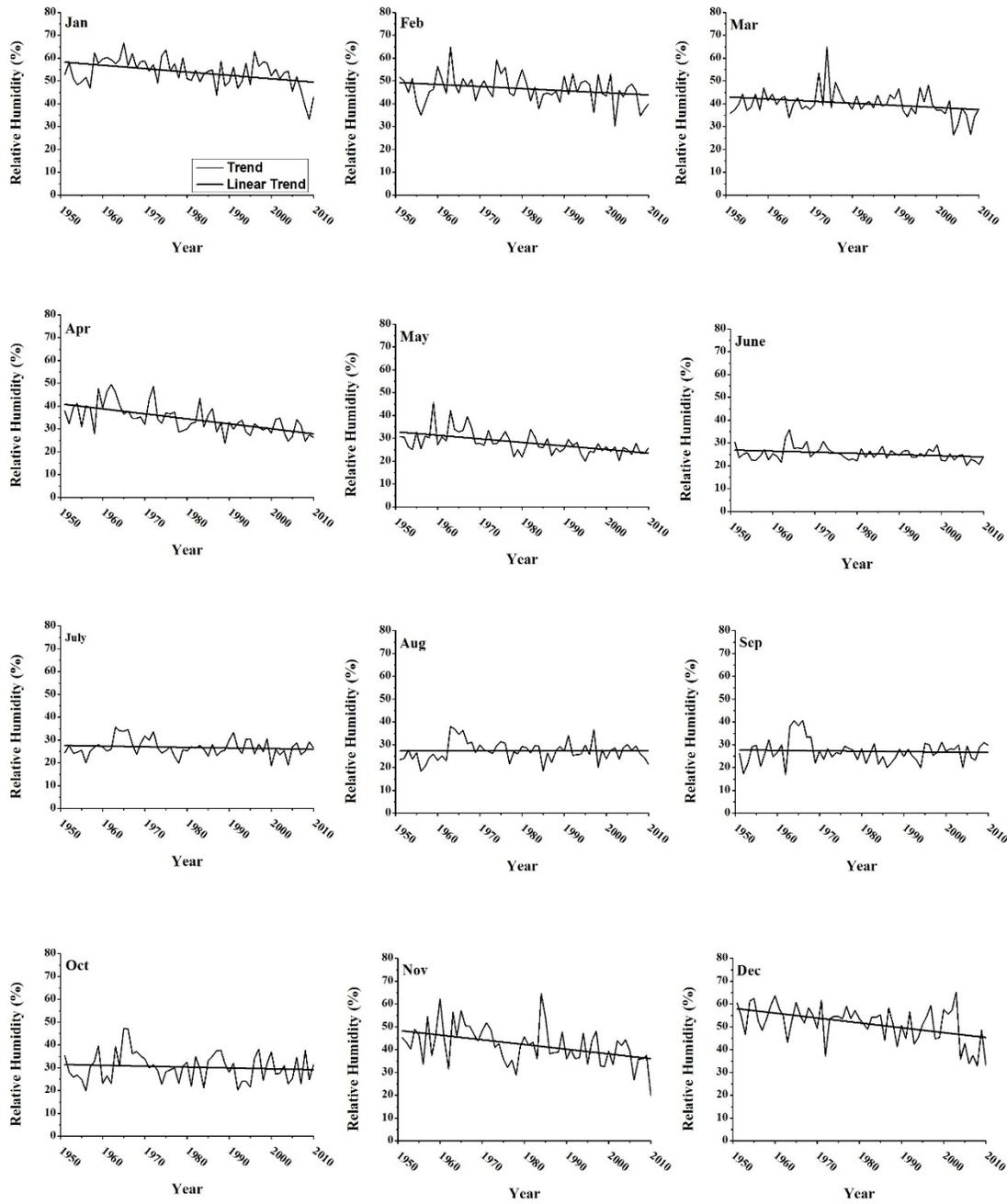


Figure 3: Time series of monthly relative humidity for Rutba city.

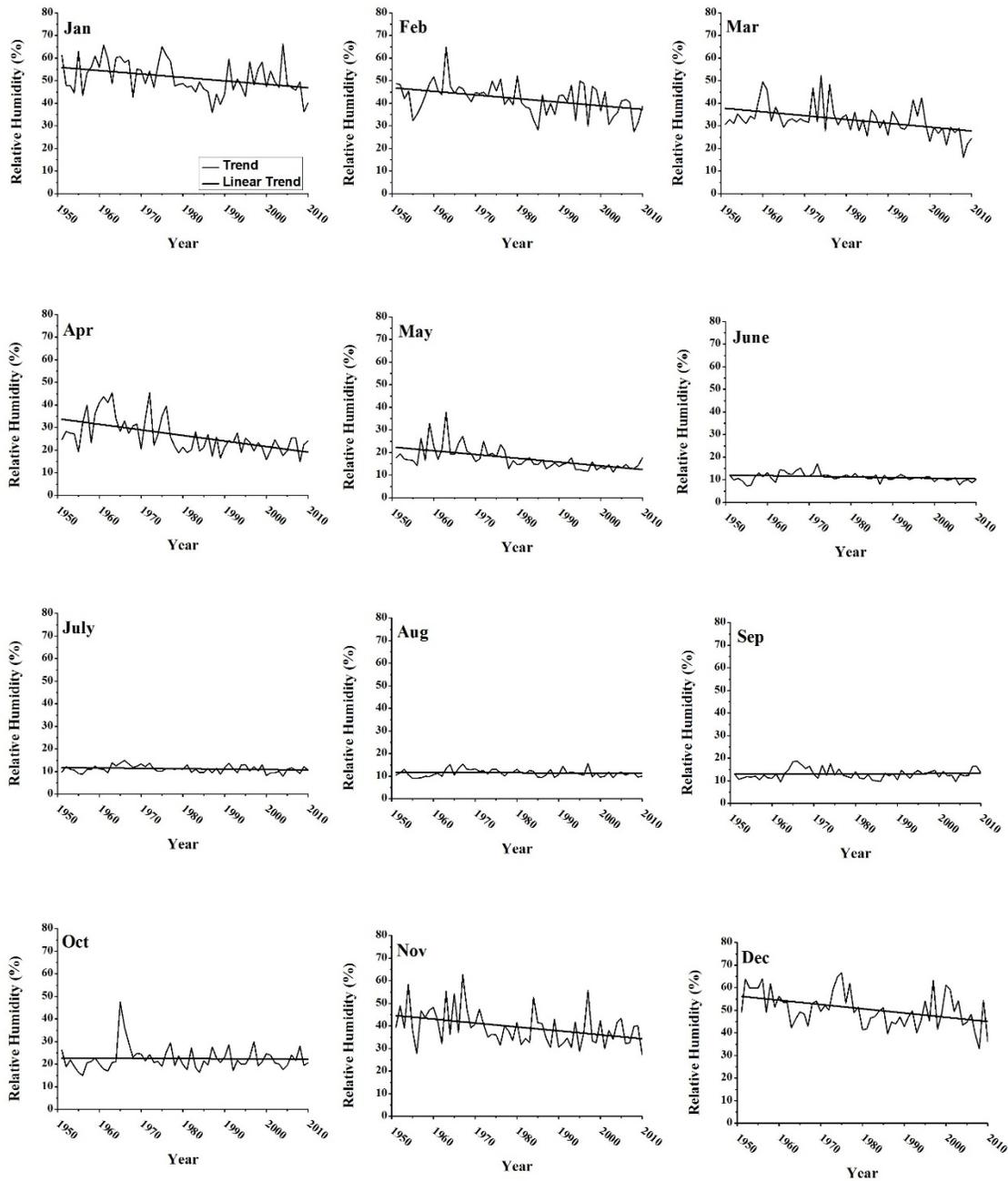


Figure 4: Time series of monthly relative humidity for Basra city.

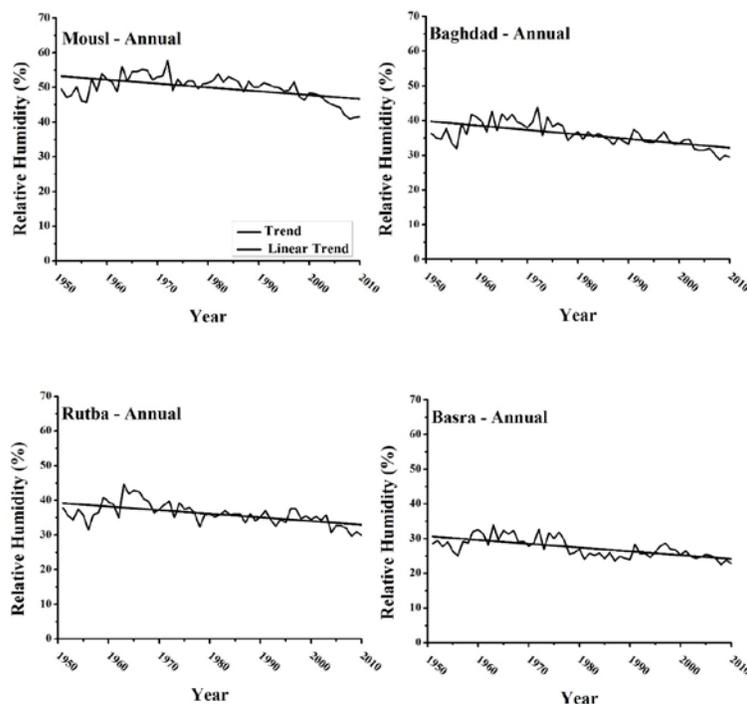


Figure 5: Annual time series of relative humidity for the four cities.

relative humidity for the four cities. It is clear that the annual relative humidity fluctuates around 50% for the northern city of Mosul and around 40% for central city of Baghdad and western city of Rutba, and around 30% for Basrah in the south. The most decreasing in annual relative humidity occurred in Mosul because of its relatively cooler climate. Table 3 summarizes the parameters of the linear regression equation for the four cities. It is seen that for Mosul and Baghdad the slope of the linear equation is negative for all months. For the Rutba, the linear trend is negative for all months except of August. Basra is characterize by negative linear trend for all months except for September and from the table its shown that the Annual linear trend is negative for all locations. Table 4 shows that the values of Mann–Kendall coefficient are comparable. It's evident that Mosul, and Baghdad stations are characterizes by negative trends for all months. Rutba station was characterize by negative trend for most of months except for the months of August and September, the coefficients are positive. Basra station was characterize by negative trend for most of months except for months of September and October, the trend was positive. The values of the correlation coefficients for Mosul, Baghdad and Basra stations are greater than 0.2 in most of months except for months of February, March, September and October for Mosul station, July, September and October for Baghdad station and July, August, September and October for Basra station the

correlation coefficients are less than 0.2. This low correlation suggests that there is small significant change in the relative humidity pattern over these regions. The statistical test for Rutba stations shows that the values of the correlation coefficients are less than 0.2 in most of months except for months of April, May, November and December the correlation coefficients are slightly greater than 0.2. This slight correlation suggests that there is no significant change in the relative humidity pattern over this region. The values of the correlation coefficients of Annual for the four cities greater than 0.3. This correlation suggests that there is substantial significant change in the annual relative humidity pattern over these regions.

I. CONCLUSION

Time series of monthly relative humidity were analysed for four cities in Iraq. Results indicated that relative humidity showed a notable decreasing trends during the most months of the year except the summer months. The summer season in Iraq is hot and dry and consequently small change in relative humidity from one year to another is expected. The northern part of Iraq was found to be the most part by the change in relative humidity. It is believed this reduction in relative humidity may be attributed to the global warming.

Table III: Monthly linear equations for selected cities

Station Month	Mosul		Baghdad		Rutba		Basra	
	b	a	b	a	b	a	b	a
January	-0.13305	343.6888	-0.11734	300.2325	-0.14851	347.8971	-0.15164	351.6067
February	0.05984	195.6546	0.13799	333.6020	-0.09163	227.9923	-0.15972	358.2697
March	0.12126	310.9111	0.16265	371.8231	-0.09286	224.0285	-0.16955	368.4757
April	0.21721	492.7017	0.30415	641.3580	-0.21859	467.1606	-0.24667	514.847
May	0.16777	378.7556	0.18751	395.5032	-0.15577	336.5617	-0.16654	347.1210
June	0.07003	169.2945	0.05453	124.1369	-0.0511	126.5186	-0.02837	67.30762
July	0.06642	154.9927	0.03769	89.08258	-0.02781	81.79037	-0.01855	47.88465
August	0.05703	134.2585	0.03634	85.83149	0.00169	23.87473	-0.00946	30.16294
September	0.03403	90.7669	0.01792	50.48665	-0.0183	63.30938	0.00606	1.01263
October	0.02545	84.19389	0.03931	102.4252	-0.0377	104.8845	-0.00919	40.59931
November	0.14921	351.6010	0.21937	479.0263	-0.20689	451.8172	-0.17374	383.4941
December	0.22912	527.6115	0.23217	521.8132	-0.21412	475.6219	-0.18886	424.5643
Annual	0.11087	269.5359	0.12892	291.2767	-0.10513	244.2881	-0.10969	244.6121

Table IV: Results of Mann–Kendall test for selected cities

Station Month	Mosul	Baghdad	Rutba	Basra
January	-0.2528	-0.2432	-0.2713	-0.2588
February	-0.0696	-0.2645	-0.1675	-0.2812
March	-0.1911	-0.2488	-0.1901	-0.3249
April	-0.4057	-0.4206	-0.4659	-0.3828
May	-0.3359	-0.4724	-0.4109	-0.4848
June	-0.2444	-0.3779	-0.1998	-0.2761
July	-0.2627	-0.1993	-0.0493	-0.1317
August	-0.2073	-0.2045	0.0091	-0.0874
September	-0.0720	-0.0591	0.0040	0.0795
October	-0.0096	-0.0658	-0.0537	0.0357
November	-0.2598	-0.3540	-0.2975	-0.2620
December	-0.3327	-0.3425	-0.2935	-0.2964
Annual	-0.3962	-0.5130	-0.4439	-0.4775

ACKNOWLEDGMENT

The author acknowledge the use of data from the US National Center for Environmental Prediction.

REFERENCES

[1] C. Souch, and C. S. B. Grimmond, "Applied climatology: 'heat waves'," Progress in Physical Geography, 2004, 28, pp. 599-606.

- [2] R. Huth, and L. Pokorna, "Parametric versus nonparametric estimates of climatic trends," *Theor Appl Climato*, 2004, 77, pp. 107–112
- [3] J. Jaagus, "Climatic changes in Estonia during the second half of the 20th century in relationship with changes in large-scale atmospheric circulation," *Theor Appl Climato*, 2006, 83, pp. 77-88..
- [4] H. Feidas, H. Nouloupoulou, T. Makrogiannis, and T. Bora-Senta , "Trend analysis of precipitation time series in Greece and their relationship with circulation using surface and satellite data: 1955-2001, " *Theor Appl Climato*, 2007, 87, pp. 155-177.
- [5] Q. Zhang, C-Y Xu, Z. Zhang, and Y. D. Chen, "Changes of temperature extremes for 1960–2004 in Far-West China , " *Stoch Environ Res Risk Assess* 2009, 23(6), pp. 721-735.
- [6] X. Liu, Z. Xu, and R. Yu, "Trend of climate variability in China during the past decades, " *Climate Change*, 2011, 109, pp. 503-516.
- [7] H. Tabari, and M- B. Aghajamloo , "Temporal pattern of monthly aridity index in Iran with considering precipitation and evapotranspiration trends," *Int J Climatol*, 2012, 3, pp. 396-409.
- [8] D. J. Gaffen, and R. J. Ross, "Trends in relative humidity in Canada from 1953–2003," *J Climate*, 1999, 12, pp. 811-828.
- [9] Van Wijngaarden, and L. A. Vincent, "Trends in relative humidity in Canada from 1953–2003," Report prepared for Climate Research Barnchm Meteorological Service Canada, 2003.
- [10] J. S., Wright, A. Sobel, and J. Galeswsky, "Diagnosis of zonal mean relative humidity in a a warmer climate," *J Climate*, 2010, 23, pp. 4559-4569.
- [11] A. A. Abi-Taleb, A. J. Alawneh, and M. M. Smadi, "Statistical analysis of recent changes in relative humidity in Jordan," *Amer J Environ Sci*, 2007, 3(2), pp. 75-77.
- [12] K. Frimpong, J. Oosthuizen, and E. J. Van Etten, , "Recent trends in temperature and relative humidity in Bauku East. Northern Ghana," *J Geog and Geology*, 2014, 6, pp. 69-81.
- [13] B. Onoz, and M. Bayazit, "The power of statistical tests for trend detection," *Turkish J Eng Environ Sci*, 2003, 27, pp. 247-251.
- [14] F. Williams, *Reasoning with statistics, Reasoning with Statistics How to Read Quantitative Research*. 4th edition, Harcourt Brace Jovnovich College Publishers, Fort Worth, 1992.

AUTHORS

First Author – Abdulwahab H. Alobaidi, Department of Electronics, Institute of Technology, Middle Technical University, Baghdad, Iraq

Correspondence Author – Abdulwahab H. Alobaidi, PhD (Atmospheric Sciences), awhalobaidi@gmail.com

Eco-Friendly Management of Pulse Beetle, *Callosobruchus chinensis* Linn. Using Botanicals on Stored Mungbean

Md. Zahid Khan, Md. Razzab Ali, Md. Serajul Islam Bhuiyan and Md. Awlad Hossain

Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh

Abstract- The experiment was conducted in the laboratory under the Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from April to July, 2011 to find out the eco-friendly management of pulse beetle, *Callosobruchus chinensis* Linn. on stored mungbean using some promising botanicals viz. dried leaf powder of neem @ 2.5 g/kg mungbean grains (T₁), bishkatali @ 2.5 g/kg mungbean grains (T₂), marigold @ 2.5 g/kg mungbean grains (T₃), dholkolmi @ 2.5 g/kg mungbean grains (T₄), chopped garlic bulb @ 1.0 g/kg mungbean grains (T₅) along with control (T₆). The experiment was laid out in Completely Randomized Design with four replications. From this study, it was observed that the treatment T₁ comprised with dried leaf powder of neem @ 2.5 g/kg mungbean grains reduced the highest percent of grain infestation by number and weight (43.12% & 41.72%, respectively) over control than other botanicals. Conversely, T₅ reduced the highest percent of adult emergence (43.65%) and grain content loss (49.91%) over control, but increased the highest percent of seed germination (25.65%) over control. Therefore, it can be concluded that dried leaf powder of neem @ 2.5 g/kg mungbean grains was the most effective control measure applied against pulse beetle, *C. chinensis* on stored mungbean.

I. INTRODUCTION

Pulses serve as one of the main sources of protein and minerals as well as play a vital socio-economic role in the diet of common people of Bangladesh. Among pulses, mungbean, *Vigna radiata* (Linn.) Wileazek has come up an important pulse crop in Bangladesh. It contains 51% carbohydrate, 26% protein, 4% minerals, 3% vitamins (Yadav *et al.*, 1994). Its sprout is a high quality vegetable and rich in vitamin-C and iron. Mungbean plant fixes atmospheric nitrogen in symbiosis with soil bacteria to enrich soil fertility as well as it provides useful fodder (Afzal *et al.*, 2004). The traders mostly store the pulses at least for few months before they sell it. Unfortunately, in storage, pulses suffer enormous losses due to bruchid attack, which infestation starts either in the field on the maturing pod and is carried to the stores with the harvested crops or it originates in the storage itself (Fletcher and Ghosh, 2002). Three species of pulse beetles, viz., *Callosobruchus chinensis* Linn., *C. analis* Fab., and *C. maculatus* Fab. have been reported from Bangladesh as the pests of stored pulses (Begum *et al.*, 1984; Rahman *et al.*, 1981 and Alam, 1971). However, Alam (1971) reported that *Callosobruchus chinensis* to cause enormous losses to almost all kind of pulses in storage condition. Rahman

(1971) reported 12.5% loss due to pulse beetles infestation in pulses stored in warehouses. Ali *et al.* (1999) reported that mungbean, *Vigna radiata* appeared to be the most common and suitable host for *C. chinensis* in respect of oviposition, egg deposition, adult emergence (66.11-70.29%) and caused 50.37 - 57.58% grain content loss in storage.

Synthetic chemicals have become a common practice among the farmers and stockholders to control the storage pests of pulses (Dilwari *et al.*, 1991; Chandra *et al.*, 1989; Singh *et al.*, 1989; Prakash and Rao, 1983; Yadav, 1983). It is now widely known that the chemical method has several problems, which include health hazards to the users and grain consumers. It causes residual toxicity, environmental pollution and development of pesticide resistance against bruchids (Srivastava, 1980). Plant-derived materials are more readily biodegradable, less toxic to mammals, more selective in action, and retard the development of resistance. Hence, search for the alternative method of pulse beetle control utilizing some non-toxic, environment friendly and human health hazard free methods are being pursued now-a-days. In Bangladesh, as many as 54 plant species have been evaluated for their bio-efficacy against different insect pests, pathogens and weeds (Karim, 1994). Bhuiyah (2001) reported that the oils of neem, royna and castor at 6 and 8 ml/kg and leaf powder of bishkatali, marigold and castor at 5% w/w were most effective in preventing the egg laying in lentil and chickpea and leaf powder of bishkatali, marigold, castor and mango at 5% were most effective in reducing the adult emergence in lentil and chickpea, whereas the adult emergence were nil in pre and post storage release methods. In considering hazards free management of *C. chinensis* using botanicals in storage aiming to assess the extent of damage of stored mungbean grains infested by *C. chinensis* as well as determining the efficacy of some botanicals against this insect pest

II. MATERIALS AND METHODS

The study was conducted to explore the efficacy of five botanicals viz. T₁=dried leaf of neem (*Azadirachta indica*), T₂=bishkatali (*Polygonum hydropiper* L.), T₃=marigold (*Calendula officinalis*), T₄=dholkolmi (*Ipomoea carnea*) and T₅=bulb of garlic (*Allium sativum*) applied against pulse beetle, *C. chinensis* L. infesting stored mungbean in the laboratory under the Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka during the period of April, 2011 to July, 2011. The experiment was laid out in the ambient condition of the laboratory considering Completely Randomized Design (CRD)

and the experiment was replicated four times for each treatment. Each of five botanicals was treated as an individual treatment. One kg of mungbean grains for each of the treatment was kept in plastic pot covered with lead. The dried leaf powder of neem, bishkatali, marigold and dholkolmi were applied at the rate of 2.5 g/kg (0.25% w/w) mungbean grains, where bulb of garlic was applied at the rate of 1 g/kg mungbean grains. Besides these botanicals, one untreated control was also considered. The experiment was replicated four times for each of the treatments. The hundred pairs of adult pulse beetle, *C. chinensis* Linn. were released in the mungbean grains kept in all plastic containers,

which were then covered with their lids and preserved in ambient temperature of the laboratory up to 120 days after insect release (DAIR) for recording data. The data on grain infestation by number and weight, adult emergence, grain content loss, and seed germinations were recorded. The data were collected and recorded at 20 days intervals started from 20 DAIR and continued up to 120 DAIR. The percent grain infestation and percent reduction of grain infestation over control were then calculated using the following formulae (Khosla, 1997):

$$\% \text{ grain infestation} = \frac{\text{Number of infested grains}}{\text{Number of total grains observed}} \times 100$$

$$\% \text{ reduction of grain infestation over control} = \frac{X_2 - X_1}{X_2} \times 100$$

Where, X_1 = Mean value of treated pot, X_2 = Mean value of untreated pot

III. RESULTS AND DISCUSSION

The study was conducted to find out the efficacy of some promising botanicals viz. dried neem leaf powder, dried bishkatali leaf powder, dried marigold leaf powder, dried dholkolmi leaf powder and bulb of garlic for eco-friendly management of pulse beetle, *Callosobruchus chinensis* Linn. infesting mungbean in the laboratory under the Department of Entomology at Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from April, 2011 to July, 2011. The findings of the study have been interpreted and discussed under the following sub-headings:

Effect of botanicals on grain infestation by number

The significant variations were observed among different botanical based management practices in terms of percent grain infestation by number throughout the storing period starting from 20 to 120 days after insect release (DAIR) considering 20 days interval during the management of pulse beetle, *C. chinensis* on mungbean. In case of 20 DAIR, the highest grain infestation (45.73%) was observed in T_6 , which was statistically different from all other treatments followed by T_3 (40.57%). This was also

followed by T_2 (31.57%) and T_5 (31.18%) (Table I). On the other hand, the lowest grain infestation (27.19%) was found in T_1 followed by T_4 (30.31%). In case of 40 DAIR, the highest grain infestation (51.40%) was recorded in T_6 , which was statistically different from all other treatments followed by T_3 (46.32%). This was also followed by T_2 (37.12%) and T_4 (36.98%) (Table I). On the other hand, the lowest grain infestation (27.20%) was recorded in T_5 (36.79%). More or less similar trends of results were also recorded in case of 60, 80, 100 and 120 DAIR in terms of percent grain infestation by number. Considering the mean grain infestation by number, the highest grain infestation (51.81%) was recorded in T_6 , which was statistically different from all other treatments followed by T_3 (48.41%). This was also followed by T_2 (39.47%). On the other hand, the lowest grain infestation (29.47%) in T_4 (38.24%) and T_5 (39.10%). In case of grain infestation reduction over control, the highest reduction (43.12%) was recorded in T_1 followed by T_4 (26.20%) and T_5 (24.54%). On the other hand, the lowest grain infestation reduction (6.57%) was observed in T_3 followed by T_2 (23.83%).

Table I: Effect of botanicals on the mungbean grain infestation by number against *C. chinensis* during April to July, 2011

Treatment	% Grain infestation by number							% infestation reduction over control
	20* DAIR	40 DAIR	60 DAIR	80 DAIR	100 DAIR	120 DAIR	Mean	
T_1	27.1e	27.2d	28.1d	29.5e	31.7e	33.0e	29.47e	43.12
T_2	31.5c	37.1c	38.8c	42.8c	42.6c	43.7c	39.47c	23.83
T_3	40.5b	46.3b	48.3b	50.7b	51.9b	52.5b	48.41b	6.57
T_4	30.3cd	36.9c	38.9c	40.5d	40.7d	41.9d	38.24d	26.20
T_5	31.1c	36.7c	39.7c	41.8c	41.9c	43.2c	39.10c	24.54
T_6	45.7a	51.4a	52.1a	52.5a	53.0a	55.9a	51.81a	--
LSD _(0.05)	1.32	1.22	1.02	1.11	1.35	0.94	0.91	--
CV(%)	3.32	2.16	3.14	3.24	3.11	2.54	3.26	--

*DAIR= Days after insect release. Figures in a column accompanied by similar letter(s) do not differ significantly at 0.05 level of probability as per DMRT. [T₁=Dried neem leaf powder @ 2.5 g/kg mungbean grain, T₂= Dried bishkatali leaf powder @ 2.5 g/kg mungbean grain, T₃= Dried marigold leaf powder @ 2.5 g/kg mungbean grain, T₄= Dried dholkolmi leaf powder @ 2.5 g/kg mungbean grain. T₅=Bulb of garlic@1g/kg grain, T₆=Untreated control]

From the above findings it was revealed that among five botanical based treatments, the T₁ comprised of dried neem leaf powder @ 2.5 g/kg grain performed as the best treatment, which reduced the highest grain infestation (43.12%) over control followed by T₄ (26.20%) comprised of dried dholkolmi leaf powder @ 2.5 g/kg grain. On the other hand, the lowest grain infestation reduction over control (6.57%) was achieved in T₃ comprised of dried marigold leaf powder @ 2.5 g/kg grain followed by T₂ (23.83%) comprised of dried bishkatali leaf powder @ 2.5 g/kg grain. The order of effectiveness of different botanicals against *C. chinensis* in terms of percent reduction of grain infestation by number is T₁ > T₄ > T₅ > T₂ > T₃. More or less similar findings were also found by several researchers. Babu *et al.* (1989) reported that among neem, karanja, mustard, groundnut and castor oils, the karanja oil (5 and 10 ml/kg) and castor oil (10 l/kg) effectively reduced the oviposition by the *C. chinensis* under conditions of artificial infestation. After 24 months of storage, the infestation of neem oil treated seed was significantly lower. Similar findings were also obtained by Veer-Singh and Yadav (2003) and Dhakshinamoorthy and Selvanarayanan (2002) and they found that neem treatment against pulse beetle was more effective.

Effect of botanicals on grain infestation by weight

The significant variations were observed among different botanical based management practices in terms of percent grain

infestation by weight throughout the storing period starting from 20 to 120 (DAIR) considering 20 days interval during the management of pulse beetle, *C. chinensis* on mungbean. In case of 20 DAIR, the highest grain infestation was found in T₆ (42.08%), which was statistically different from all other treatments followed by T₃ (38.75%) and also followed by T₄ (36.25%) and T₂ (33.33%) (Table II). On the other hand, the lowest grain infestation by weight in T₁ (22.25%) followed by T₅ (27.19%). In case of 40 DAIR, the highest grain infestation (43.75%) was also recorded in T₆, which was statistically different from all other treatments followed by T₃ (42.92%) (Table II). This was also followed by T₄ (37.92%) and T₂ (35.00%). On the other hand, the lowest grain infestation was found in T₁ (22.08%). More or less similar trend of results were also observed in case of 60, 80, 100 and 120 DAIR in terms of percent grain infestation by weight. Considering the mean grain infestation by weight, the highest grain infestation (46.11%) was recorded in T₆, which was statistically different from all other treatments followed by T₃ (45.07%). This was also followed by T₄ (39.79%). On the other hand, the lowest grain infestation by weight was found in T₁ (26.88%) followed by T₅ (35.35%). In case of grain infestation reduction over control, the highest reduction (41.72%) was recorded in T₁ followed by T₅ (23.35%) and T₂ (15.67%). On the other hand, the lowest grain infestation reduction (2.25%) was recorded in T₃ followed by T₄ (13.70%).

Table II: Effect of botanicals on the mungbean grain infestation by weight against *C. chinensis* during April to July, 2011

Treatment	% Grain infestation by weight							% infestation reduction over control
	20 DAIR	40 DAIR	60 DAIR	80 DAIR	100 DAIR	120 DAIR	Mean	
T ₁	21.25f	22.08f	23.33e	27.92e	32.92e	33.75d	26.88e	41.72
T ₂	33.33d	35.00d	38.33c	40.83c	41.25c	44.58b	38.89c	15.67
T ₃	38.75b	42.92b	45.00b	46.25b	47.75b	49.75a	45.07ab	2.255
T ₄	36.25c	37.92c	38.33c	40.00c	41.67c	44.58b	39.79c	13.70
T ₅	28.75e	32.08e	35.00d	37.08d	38.33d	40.83c	35.35d	23.35
T ₆	42.08a	43.75a	45.83a	47.08a	47.92a	50.00a	46.11a	--
LSD (0.05)	0.48	0.65	1.02	1.10	0.86	1.27	0.94	--
CV(%)	3.02	3.36	2.28	3.58	3.18	3.34	2.27	--

*DAIR= Days after insect release. Figures in a column accompanied by similar letter(s) do not differ significantly at 0.05 level of probability as per DMRT. [T₁=Dried neem leaf powder @ 2.5 g/kg mungbean grain, T₂= Dried bishkatali leaf powder @ 2.5 g/kg mungbean grain, T₃= Dried marigold leaf powder @ 2.5 g/kg mungbean grain, T₄= Dried dholkolmi leaf powder @ 2.5 g/kg mungbean grain. T₅=Bulb of garlic@1g/kg grain, T₆=Untreated control]

From the above findings it was revealed that among five botanical based treatments, the T₁ comprised of dried neem leaf powder @ 2.5 g/kg grain also performed best result, which reduced the highest grain infestation (41.72%) over control followed by T₅ (23.35%) comprised of bulb of garlic @ 1.0 g/kg grain. On the other hand, the lowest grain infestation reduction over control (2.25%) was achieved in T₃ comprised of dried marigold leaf powder @ 2.5 g/kg grain followed by T₄ (13.70%)

comprised of dried dholkolmi leaf powder @ 2.5 g/kg grain. The order of effectiveness of different botanicals against *C. chinensis* in terms of grain infestation reduction by weight is T₁ > T₅ > T₂ > T₄ > T₃. Similar findings were also obtained by Veer-Singh and Yadav (2003) and Dhakshinamoorthy and Selvanarayanan (2002) and they found that neem treatment against pulse beetle was more effective.

Effect of botanicals on the adult emergence of *C. chinensis* during its management

The significant variations were observed among different botanical based management practices in terms of adult emergence throughout the storing period starting from 40 to 120 (DAIR) considering 20 days interval during the management of pulse beetle, *C. chinensis* on mungbean. In case of 40 DAIR, the highest number of adult emergence was recorded in T₆ (3.67/10 infested grains) which was statistically different from all other treatments followed by T₁ (3.33/10 infested grains) and also followed by T₂ (3.00/10 infested grains) (Table III). On the other hand, the lowest number of adult emergence was recorded in T₅ (1.00/10 infested grains) followed by T₃ (2.00/10 infested grains). In case of 60 DAIR, the highest number of adult emergence (6.00/10 infested grains) was recorded in T₆, which was statistically different from all other treatments followed by T₂ (5.33/10 infested grains) (Table III). This was also followed by T₁ (5.00/10 infested grains) and T₄ (4.67/10 infested grains).

On the other hand, the lowest adult emergence was recorded in T₅ (3.33/10 infested grains). More or less similar trends of results were also recorded in case of 80, 100 and 120 DAIR regarding the number of adult emergence of pulse beetle during its management. Considering the mean adult emergence, the highest number adult emergence (6.27/10 infested grains) was recorded in T₆, which was statistically different from all other treatments followed by T₂ (5.33/10 infested grains). This was also followed by T₁ (5.13/10 infested grains). On the other hand, the lowest number of adult emergence was recorded in T₅ (3.53/10 infested grains) followed by T₄ (4.93/10 infested grains). In case of adult emergence reduction by number over control, the highest reduction (43.65%) as recorded in T₅ followed by T₄ (21.28%) and T₁ (18.12%). On the other hand, the lowest adult emergence reduction by number (14.90%) was recorded in T₂ followed by T₃ (17.04%).

Table III: Effect of botanicals on adult emergence during 40 days after insect release to 120 days after insect release of *C. chinensis*

Treatment	Adult emergence (No./10 infested seeds)						Percent reduction over control
	40 DAIR	60 DAIR	80 DAIR	100 DAIR	120 DAIR	Mean	
T ₁	3.33b	5.00c	5.00d	5.33d	7.00c	5.13b	18.12
T ₂	3.00c	5.33b	5.67c	6.00c	6.67d	5.33b	14.90
T ₃	2.00d	4.00e	6.00b	6.67b	7.33b	5.20b	17.04
T ₄	3.00c	4.67d	4.67e	5.33d	7.00c	4.93c	21.28
T ₅	1.00d	3.33f	4.00f	4.33e	5.00e	3.53d	43.65
T ₆	3.67a	6.00a	6.67a	7.33a	7.67a	6.27a	--
LSD _(0.05)	0.03	0.04	0.04	0.03	0.05	0.21	--
CV(%)	2.03	3.02	3.64	3.43	3.00	3.11	--

*DAIR= Days after insect release. Figures in a column accompanied by similar letter(s) do not differ significantly at 0.05 level of probability as per DMRT. [T₁=Dried neem leaf powder @ 2.5 g/kg mungbean grain, T₂= Dried bishkatali leaf powder @ 2.5 g/kg mungbean grain, T₃= Dried marigold leaf powder @ 2.5 g/kg mungbean grain, T₄= Dried dholkolmi leaf powder @ 2.5 g/kg mungbean grain. T₅=Bulb of garlic@1g/kg grain, T₆=Untreated control]

From the above findings it was revealed that among five botanical based treatments, the T₅ comprised of bulb of garlic @ 1.0 g/kg grain performed as the best treatment, which reduced the highest adult emergence by number (43.65%) over control followed by T₄ (21.28%) comprised of dried dholkolmi leaf powder @ 2.5 g/kg grain. On the other hand, the lowest adult emergence reduction over control (14.90%) was achieved by T₂ comprised of dried bishkatali leaf powder @ 2.5 g/kg grain followed by T₃ (17.04%) comprised of dried marigold leaf powder @ 2.5 g/kg grain. The order of effectiveness of different botanicals against *C. chinensis* in terms of adult emergence reduction by number is T₅ > T₄ > T₁ > T₃ > T₂. The results obtained from Saxena and Saxena (2009) was not similar. They found that neem kernel was more effective than garlic. Two per cent concentration of garlic solvents also showed 50% mortality in mungbean crops. Similar result was also found by Singal and Chauhan (2008).

Effect of botanicals on the grain content loss caused by *C. chinensis*

Grain content losses by weight were significantly varied by different botanicals applied against pulse beetle, *C. chinensis* during its management. After 4 months (i.e. 120 DAIR), it was observed that the highest grain content loss was found in T₆ (48.33%), which was statistically different from all other treatments followed by T₃ (42.67%) and T₄ (34.00%) (Table IV). On the other hand, the lowest grain content loss by weight (24.21%) was recorded in T₅ followed by T₂ (28.55%). In case of grain content loss reduction over control, the highest reduction (49.91%) was recorded in T₅ followed by T₂ (40.93%) and T₁ (33.44%) (Table IV). On the other hand, the lowest grain content loss reduction over control (11.71%) was recorded in T₃ followed by T₄ (29.65%).

Table IV: Effect of botanicals on mungbean grain content loss at 120 days after insect release of *C. chinensis*

Treatment	% grain content loss by weight	% grain content loss reduction over control
T ₁	32.17d	33.44
T ₂	28.55e	40.93
T ₃	42.67b	11.71
T ₄	34.00c	29.65
T ₅	24.21e	49.91
T ₆	48.33a	--
LSD (0.05)	1.03	--
CV(%)	2.00	--

Figures in a column accompanied by similar letter(s) do not differ significantly at 0.05 level of probability as per DMRT. [T₁=Dried neem leaf powder @ 2.5 g/kg mungbean grain, T₂= Dried bishkatali leaf powder @ 2.5 g/kg mungbean grain, T₃= Dried marigold leaf powder @ 2.5 g/kg mungbean grain, T₄= Dried dholkolmi leaf powder @ 2.5 g/kg mungbean grain. T₅=Bulb of garlic@1g/kg grain, T₆=Untreated control]

From the above findings it was revealed that among five botanical based treatments, the T₅ comprised of bulb of garlic @ 1.0 g/kg grain performed as the best treatment, which reduced the highest grain content loss (49.91%) over control followed by T₂ (40.93%) comprised of dried bishkatali leaf powder @ 2.5 g/kg grain. On the other hand, the lowest grain content loss reduction over control (11.71%) was achieved in T₃ comprised of dried marigold leaf powder @ 2.5 g/kg grain followed by T₄ (29.65%) comprised of dried dholkolmi leaf powder @ 2.5 g/kg grain. The order of effectiveness of different botanicals against *C. chinensis* in terms of grain infestation reduction is T₅ > T₂ > T₁ > T₄ > T₃. Under the present study, garlic showed the best result and it might be due to cause of its pungent smell and also its chemical properties that cause reduced attack of pulse beetle and as a result of lowest grain content loss.

Effect of botanicals on viability mungbean of seed

The significant variations were observed among different botanical based management practices in terms of percent germination by number of mungbean seed throughout the storing period starting from 20 to 120 DAIR considering 20 days interval during the management of pulse beetle, *C. chinensis* on mungbean. In case of 20 DAIR, the maximum seed germination

was recorded in T₅ (94.67%), which was statistically different from all other treatments followed by T₁ (92.67%) and also followed by T₄ (88.67%) (Table V). On the other hand, the minimum percent seed germination in T₆ (84.67%) followed by T₂ (88.00%). In case of 40 DAIR, the maximum germination by number (92.67%) was recorded in T₅ which was statistically different from all other treatments followed by T₃ (82.67%) (Table V). This was also followed by T₄ (80.00%) and T₁ (78.67). On the other hand, the minimum seed germination was recorded in T₆ (77.33%) followed by T₁ (78.67). More or less similar trends of results were also recorded in case of 60, 80, 100 and 120 DAIR in terms of per cent germination of mungbean seed. Considering the mean germination, the maximum germination of mungbean seed (91.45%) was observed in T₅, which was statistically different from all other treatments followed by T₃ (79.00%). This was also followed by T₁ (78.89%). On the other hand, the minimum germination was found in T₆ (72.78%) followed by T₂ (75.33%). In case of seed germination increase over control, the highest increase (25.65%) was recorded in T₅ followed by T₃ (8.55%) and T₁ (8.40%). On the other hand, the lowest percent germination increase (3.51%) over control was recorded in T₂ followed by T₄ (5.65%).

Table V: Effect of botanicals on the germination of mungbean during 20 days after insect release to 120 days after insect release of *C. chinensis*

Treatment	% seed germination by number							% germination increase over control
	20 DAIR	40 DAIR	60 DAIR	80 DAIR	100 DAIR	120 DAIR	Mean	
T ₁	92.6b	78.6d	78.0b	76.0b	76.0b	72.0c	78.8b	8.40
T ₂	88.0c	78.6d	76.0d	71.3d	70.0d	68.0e	75.3d	3.51
T ₃	88.0c	82.6b	78.6b	75.3c	76.0b	73.3b	79.0b	8.55
T ₄	88.6c	80.0c	77.3c	75.3c	70.67d	69.3d	76.8c	5.65
T ₅	94.6a	92.6a	91.3a	90.6a	90.0a	89.3a	91.4a	25.65
T ₆	84.6d	77.3e	73.3e	70.0e	67.3e	64.0f	72.7e	--
LSD (0.05)	0.68	0.74	0.82	0.64	0.66	0.58	0.67	--
CV(%)	3.12	2.66	2.10	3.38	2.11	3.00	3.01	--

DAIR= Days after insect release. Figures in a column accompanied by similar letter(s) do not differ significantly at 0.05 level of probability as per DMRT. [T₁=Dried neem leaf powder @ 2.5 g/kg mungbean grain, T₂= Dried bishkatali leaf powder @ 2.5 g/kg

mungbean grain, T₃= Dried marigold leaf powder @ 2.5 g/kg mungbean grain, T₄= Dried dholkolmi leaf powder @ 2.5 g/kg mungbean grain. T₅=Bulb of garlic@1g/kg grain, T₆=Untreated control]

From the above findings it was revealed that among five botanical based treatments, the T₅ comprised of bulb of garlic @ 1.0 g/kg grain performed as the best treatment, which increased the highest seed germination (25.65%) over control followed by T₃ (8.55%) comprised of dried marigold leaf powder @ 2.5 g/kg grain. On the other hand, the lowest seed germination increase over control (6.57%) was found in T₂ comprised of dried bishkatali leaf powder @ 2.5 g/kg grain followed by T₄ (5.65%) comprised of dried dholkolmi leaf powder @ 2.5 g/kg grain. The order of effectiveness of different botanicals against *C. chinensis* in terms of seed germination increase is T₅ > T₃ > T₁ > T₄ > T₂. This result might be due to cause of garlic's repulsive and chemical characters that cause reduced infestation of grains and resulted highest germination of seeds.

Considering the findings of the study, on stored mungbean the dried neem leaf powder may be recommended for eco-friendly management of *Callosobruchus chinensis* Linn.

REFERENCES

- [1] Afzal, M.A., Bakar, M.A., Halim, A., Haque, M.M. and Akter, M.S. (2004). Mungbean in Bangladesh. Lentil Blackgram and Mungbean Development Pilot Project, BARI, Gazipur-1701. Pub. No-23. P.60.
- [2] Alam, M.Z. (1971). Pest of stored grains and other stored products and their control. The Agriculture Information Service, Publ. Dhaka-61.
- [3] Ali, M.R., Rahman, M.M., Rahman, M.M., Ali, M. and Quamruzzaman, A.K.M. (1999). Studies on the host preference of pulse beetle, *Callosobruchus chinensis* Linn. to different pulses. J. Agric. Edu. Tech. 2(2): 139-144.
- [4] Begum, A., Debnath, S.K. and Seal, D.R. (1984). Studies on the food, temperature and humidity on the fecundity and development of *Callosobruchus chinensis* Fab. (Coleoptera: Bruchidae). Bangladesh J. Zool. 12(2): 71-78.
- [5] Bhuiyah, M., Mia, I. (2001). Damage of some stored pulses by the pulse beetle, *Callosobruchus chinensis* L. And its control with botanicals. Ph.D. Thesis, Department of Entomology, Bangladesh Agricultural University, Mymensingh, p. 149.
- [6] Chandra, S., Khare, B.P. and Sharma, V.K. (1989). Efficacy of some selected fumigants on rice-weevil, *Sitophilus oryzae* Linn. Indian J. Agril. Res. 12(2): 79 - 84.
- [7] Dhakshinamoorthy, G. and Selvanarayanan, V. (2002). Evaluation of certain natural products against pulse beetle, *Callosobruchus maculatus* (Fab.) infesting stored green gram. Department of Entomology, Faculty of Agriculture, Annamalai University, Annamalai Nagar 608002, Tamilnadu, India. Insect Environ. 8(1): 29-30.
- [8] Dilwari, V. K., D.G. Dhaluiwal and M.S. Mahal. 1991. Toxicity of allylisothiocyanate to rice moth. *Sitotroga cerealella* Linn. J. Insect. Sci. 4(1):101-102.
- [9] Fletcher, T.B and Ghosh, C.C. (2002). Stored grain pests. Rep. Proc. 3rd Ent. Meeting, Pusa, New Delhi, pp. 712-716.
- [10] Karim, A.N.M.R. (1994). Status of botanical pest control in Bangladesh. Paper presented at the Expert consultation on Regional Perspective for use of Botanical pesticides in Asia and the Pacific, Bangkok, Thailand.
- [11] Khosla, R.K. (1997). Techniques for assessment of losses due to pest and diseases of rice. Indian J. Agric. Sci. 47(4): 171-174.
- [12] Prakash, A, and Rao, J. (1983). Insect pests and their management in rice storage in India, presented in National Symposium on Maximising and Stabilising of yields on rain fed rice production system held at CSIRRI, Cuttack (India) on Feb., pp. 23 -25.
- [13] Rahman, M.M., Mannan, M.A. and Islam, M.A. (1981). Pest survey of major summer and winter pulse in Bangladesh. In proceeding the National Workshop on pulse, held during August 18-19, 1981. Bangladesh Agricultural Research Institute, Joydebpur, Dhaka. pp. 265-273.
- [14] Rahman, S. (1971). Study on the morphology and biology of *Callosobruchus chinensis* Linn. C. analis Fab and extent of damage to pulses, M.Sc. Thesis, Dept. of Zoology, Dacca University. p.199.
- [15] Saxena, R. and Saxena, B. (2009). Bioactivity of certain plant extracts against *Callosobruchus maculatus* (Fabr.) in mungbean. J. Appl. Zool. Res. 11(1): 29-32.
- [16] Singal, S.K. and Chauhan, R. (2008). Effect of some plant products and other materials on development of pulse beetle, *Callosobruchus chinensis* (L.) on stored pigeonpea, *Cajanus cajan* (L.) Millsp. J. Insect Sci. 10(2): 196-197.
- [17] Singh, D., Siddiqui, M.S. and Sharma S. (1989). Reproduction retardant and fumigant properties of essentials oils against rice weevil (Coleoptera: Curculionidae), in stored wheat. J. Econ. Entomol. 82(3): 727 - 733.
- [18] Srivastava, S., Gupta, K.C. and Agarwal, A. (1980). Effect of plant product on *Callosobruchus chinensis* L. infestation on red gram. Rev. Appl. Entomol. 77(9): 781.
- [19] Veer-Singh and Yadav, D.S. (2003). Efficacy of different oils against pulse beetle, *Callosobruchus chinensis* in greengram, *Vigna radiata* and their effect on germination, Dept. of Entomol. College of Agriculture, RAU, Bikaner- 334 006, India. Indian J. Ent., 65(2): 281-286.
- [20] Yadav, D.S., Panwar, K.S. and Sing, V.K. (1994). Management of pulse crops in sequential cropping. Indian Abst. Proc. Intercropping. Symposium on pulse Research. 2-6 April, 1994, New Delhi, India. 27p.
- [21] Yadav, T.D. (1983). Seed fumigation as an aspect to seed storage technology. Seed Res., 11(2): 240 - 247.

AUTHORS

First Author – Md. Zahid Khan, B.Sc.Ag.(Hons.), M.S in Entomology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, e-mail- zkhan_102@yahoo.com

Second Author – Professor Dr. Md. Razzab Ali, Dept. of Entomology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, e-mail- razzab1968@yahoo.com

Third Author – Professor Dr. Md. Serajul Islam Bhuiyan, Dept. of Entomology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, e-mail- dmseraj@hotmail.com

Fourth Author – Md. Awlad Hossain, B.Sc.Ag.(Hons.), M.S in Agricultural Chemistry(Thesis semester), Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, e-mail- awladsau@gmail.com

Efficacy of Cognitive Behaviour Therapy for a Moderately Depressed Client: A Clinical Case Study

Angana Mukherjee

Consultant Clinical Psychologist, The Reach Clinic, Koramangala, Bangalore, India

Abstract- The case study illustrates the management of a young female, referred to as “Amrita”, who presented with features of depression along with death wishes and decline in her personal, social and occupational performance. Assessments through Beck Depression Inventory (BDI) and Hamilton Depression Rating Scale (HAM-D) revealed features of moderate level of depressive features. Nine sessions of Cognitive-Behavioral Therapy (CBT) was conducted including one follow up session. Amrita’s progress throughout the treatment sessions is illustrated in detail in the following case study report. Results corroborate to the previous studies of efficacy of CBT for use with depression. The purpose of the therapy was exploration and resolution of the maladaptive thoughts, feelings and behaviour for a greater sense of autonomy, well being; achieving higher levels of functioning and problem-solving along with developing insight and personality growth. The purpose of the case study report was also exploration of the reasons for discontinuation for the booster sessions.

Index Terms- depression, Cognitive Behaviour Therapy, Beck Depression Inventory (BDI), Hamilton Depression Rating Scale (HAM-D)

I. INTRODUCTION

Depression is thought to be as common as common cough and cold. Depression, a psychological disorder, is a sustained emotional state rather than a temporary, mild mood state. It is an assemblage of experiences of mood, physical functioning, quality of thinking, outlook and behaviours. In contrast to the normal emotional responses to unwanted and stressful events, clinical depression is a mental disorder which, due to its severity, its tendency to recur and its high cost for the individual and for the society, is a medically significant condition that needs to be diagnosed and properly treated. Depressed mood can be differentiated from the other non-morbid emotional reaction of sadness by its intensity, depth, its impact on

individual’s personal, social and occupational life and its duration.

The clinical features of Depression is illustrated as follows:

Box :1 Depressive Episode: Diagnosis and Clinical Features:

At least two of the following should be present for a minimum 2 weeks:

1. Depressed mood to a degree that is definitely abnormal for the individual, present for most of the day and almost everyday, largely uninfluenced by circumstances.
 2. Loss of interest or pleasure in activities that are normally pleasurable
 3. Decreased energy or increased fatigability
- B. Additional symptoms, two or more of the following:
1. Loss of confidence and self-esteem
 2. Self-reproach or excessive and inappropriate guilt
 3. Recurrent thoughts of death or suicide, or any suicidal behavior
 4. Diminished ability to think or concentrate
 5. Change in psychomotor activity (agitation or retardation)
 6. Sleep disturbances
 7. Change in appetite with corresponding weight change

References: Adapted from ICD-10: World Health Organisation. The ICD-10 Classification of Mental and Behavioural Disorders. Geneva: WHO, 1992

The diagnosis of depression is based on a set of specific signs and symptoms. (World Health Organization,1992). (Box 1). A clinician needs to have adequate knowledge, skills and expertise to elicit these symptoms. The common symptoms of depression are:

- a. a persistently depressed mood;
- b. a loss of interest in activities which were earlier considered as pleasurable; and
- c. easy fatigability.

Table :1: Chart showing the common symptoms of depression

COGNITIVE	AFFECTIVE	CONATIVE	PHYSIOLOGICAL
"I am a failure" "I am worthless" "its my fault" "nothing good happens to me" "life is not worth living"	Sadness/tearful Anxiety Irritable Frustrated Guilt Overwhelmed Indecisive Miserable Disappointment	Unable to concentrate Stopped going out Withdrawn from family and friends Not participating in previously liked activities Relying on alcohol or other substances	Tiredness Fatigue Headache and other muscle pain Sleep disturbance Loss of appetite/weight gain/loss

Prevalence studies

Several studies were conducted on the prevalence rates of depression. A study done by Bromet, Andrade, Hwang, Sampson, Alonso, de Girolamo (2011), revealed a lifetime prevalence of depression in about 10-15% of cases and at least 5% as yearly prevalence rate of depression (Murphy et al.,2000). Another recent large sample survey revealed overall prevalence in Indian context was found to be 15.9% (Poongothai, Pradeepa, Ganesan, Mohan, 2009) indicating an increase in prevalence of depression over few decades (Nandi, Banerjee, Mukherjee, Ghosh, Nandi, and Nandi, 2000) in India also about 21-84% of primary health care settings in India (Pothen, et al.,2003 ;Amin, Shah, and Vankar,1998). Derasari and Shah,(1988) also pointed out that in Indian patients there is a high prevalence of physical and somatic symptoms than in western population. Atleast 50% of individuals having the diagnosis of depression committed suicide indicating a high risk of suicide in depression. (Reddy,2010). Nolen-Hoeksema (1990), conducted a large population-based study in Chennai and found that the prevalence of depression was almost 15.1% among south Indians. A study by Poongothai, Pradeepa, Ganesan, and Mohan, (2009) revealed prevalence of depression was mostly observed to be higher in the low income group and in those with lower level of education compared to those who were better educated. Another study done in Bangalore by Hussain, Creed and Thompson (2000), found that, among young adults attending college, men were found to be more depressed (25%) than women (18%). In the WHO study done in primary care centers by Goldberg and Lecrubier(1995), found that atleast 9.1% of the individuals in Bangalore city was affected with depression. In 1992 in Illinois in USA (Mirowsky and Ross,1992), it was reported that depression reached its lowest level in the middle age at about the age of 45, with a rise in later life [>80 years], reflecting life cycle gains and losses related to marriage, employment and economic well being as the possible causes. Poongothai, Pradeepa, Ganesan, and Mohan, (2009) also cited that major depressive

disorder mostly is common among people who does not have close interpersonal relationships, and/ or individuals who are divorced or separated.

Results of previous studies show that depression may last for about 6 months to 1 year without treatment and with treatment, remission occurs within few weeks. However, depression can recur within 5 years and atleast two-thirds of the population suffer from chronic depression (Sadock and Sadock,2007; Remick,2002)

Comorbidity

Major depression frequently co-occurs with other psychiatric problems. According to the 1990–92 National Comorbidity Survey (US) atleast 51% of those with major depression also suffer from lifetime anxiety, and individuals diagnosed with ADHD might develop comorbid depression.(Kessler, Nelson, McGonagle, Liu, Swartz, Blazer 1996).According to a study done by The National Institute of Mental Health (NIMH),(2008), it was suggested that there is a high risk of having alcohol abuse or dependence, panic disorder, obsessive compulsive disorder (OCD), social anxiety disorder and other Axis I disorders as comorbid disorders of depression (Grant,1995).

Theoretical Perspectives:

No single cause can explain the etiological factors for depression. The different schools of thought have explained depression in the following way:

A. Biological—

Both heredity and environment has their respective roles to play in causing depression. The Biological theorists explain that depression, unipolar and/or bipolar can be result of a vulnerability or having a predisposition to mood disorder. Findings as obtained from different twin studies and family studies suggested that this vulnerability could be

“polygenetically transmitted”. (Harrington,1993). Results from these studies showed a biological vulnerability to dysregulation of the amine system, (Deakin,1986) dysregulation of the endocrine system,(Deakin,1986) dysregulation in the immune system,(Levy and Heiden,1991) dysregulation of the circadian rhythm (Kupfer and Reynolds,1992) and/or seasonal occurrence of depression (Wehr and Rosenthal, 1989), could be inherited factors which can be explained as possible causes for mood disorder.(Carr,1999).

B.Psychological Theories:

According to the Family system_ model the cause does not lie not within the individual but within the structure and functioning of the family as a system. Depression can result when there is a misbalance in the structure and function of the family which might prevent the individual from performing “age-appropriate developmental tasks”. Extreme parental criticism, overprotection, selectively focussing only on the failures than the success might affect the individual’s self esteem leading to depression. Also enmeshed relationship among the family members can also cause an hindrance to the proper development of a sense of individuation.(Carr,1991)

From Freud’s Psychoanalytic perspective, depression can be explained as anger turned inward, towards the self. When an actual or perceived loss of a loved object or a caregiver occurs, the anger is directed as a part of the self which represent the lost object.(Carr,1999)

Bibring’s low self-esteem theory says that often individuals form an unrealistic ideal self on the basis of internalizations of early parental sanctions which were probably highly critical or perfectionistic. As a result a perceived gap between the actual self and the ideal self develops leading to low self-esteem, which in turn can lead to depression.(Blatt and Zuroff,1992).

Blatt’s attachment and autonomy theory explains that at times neglecting parenting, overindulgent parenting, critical and punitive parenting can lead a loss of sense of autonomy in the individual. Also loss of attachment relationships can sometimes lead to depression. (Blatt and Zuroff,1992)

Lewinson’s behavioural theory explains that depressed people also might lack the necessary social skills for maintaining a “rewarding interactions” from others. They make efforts to avoid situations where they perceive that they might receive “response contingent positive reinforcement (RCPR)” (Lewinsohn et al., 1990)

Reformulated Learned helplessness theory explains that repeated failures of an individual, to effectively deal with the perceived or actual aversive stimuli can lead him to attribute to him/herself as responsible for these failures and unstable attributions to the external factors for success.(Seligman,1981)

As explained by Beck’s cognitive theory—early negative learning experiences help in formation of negative assumptions regarding self, world and future. These negative schemas when activated gives rise to negative automatic thoughts and cognitive distortions which maintain the depressed mood.(Beck,1976; Williams,1992; Carr,1999).

Psychotherapeutic Treatment Approach

Earlier studies suggest CBT can be considered as the “first-line psychosocial treatment of choice, at least for patients with

anxiety and depressive disorders”. (Tolin,2010) A study by Whitfield and Williams (2003), also revealed “extensive evidence for the effectiveness of CBT for depression”. “CBT in the treatment of depression is one of the therapeutic modalities with the highest empirical evidence of efficacy, whether applied alone or in combination with pharmacotherapy” (Powell, Abreu, Oliveira and Sudak,2008). Also previous case studies on the use and efficacy of CBT on first onset depression and dysthymia can also be cited here. (Thomas and Drake, 2012).

Going in the same line with the previous studies CBT was chosen to be the treatment approach for the present case of Amrita.

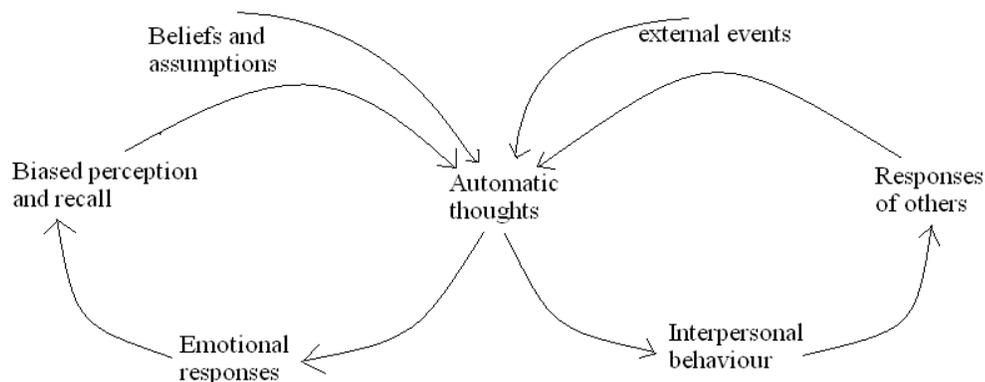
Cognitive Behaviour Therapy (CBT)_is an amalgamation of [Behavior Therapy](#) with [Cognitive Therapy](#), focusing primarily on the “here and now” principle. The [National Institute for Health and Clinical Excellence](#) recommends CBT as the “treatment of choice for a number of [mental health](#) problems, including [post-traumatic stress disorder](#), [OCD](#), [bulimia nervosa](#), and [clinical depression](#)..”(Driessen, Hollon and Steven 2010). The approach that is followed is “Collaborative Empiricism” or in other words building trust in the client. It is an active learning process, based on open-ended questioning and is highly structured and focused therapy. (Kazantzis, Beck, Dattilio, Dobson, and Rapee 2013).

Cognitive behavior therapy follows a straightforward common sense model stressing on the inter relationship among cognition, emotion and behavior.CBT can be divided into three basic tenets that is Cognitive principle (interpretations or meanings that one draws from the situations) ,Behavioural principle (the actions or the overt behaviours that one does which in turn are highly influenced by thoughts and emotions and vice versa) and the Continuum principle – (mental health problems can be best hypothesized as “exaggerations of normal processes”). (Westbrook, 2011).

Basic Concepts

Automatic thoughts comprise one of the basic premises of CBT. It silhouettes the emotions and actions of an individual in response to any situation. They are immediate, automatic, spontaneous in nature.The perceptions and meanings that one draws from the events are largely prejudiced by the “beliefs, assumptions and schemas” of the individual. The cognitive distortions or logical errors in cognition are highly responsible for formation of flawed deductions. (Beck, 1976) . Cognitive distortions are more accessible in automatic thoughts and are responsible for maintaining the distress that an individual experiences. Common examples of cognitive distortions are dichotomous thinking, overgeneralization, selective abstraction, arbitrary inference etc. (Hawton, Salkovskis, Kirk, and Clark, 2001)

Figure I: Figure showing the role of cognition in psychopathology



Reference: Freeman, Pretzer, Fleming and Simon, 1990.

From the above figure it can be assumed that any individual is susceptible to formation of any kind of dysfunctional beliefs or assumptions regarding self, the world or the future. However, this assumption remains dormant until a situation arises which might activate these dormant negative assumptions. Here the cognitive distortions play a crucial role in contributing to the emergence of negative automatic thoughts. A perpetuating cycle often builds up including the automatic thoughts, cognitive distortions along with the prevalent mood state. Depending upon the content of these automatic thoughts, the dysfunctional automatic thoughts elicit a corresponding mood. This mood again tends to biases most of the past memories and perceptions in a way that the individual experiences some “additional dysfunctional automatic thoughts, intensifying her/his mood”. This again tends to bias further memories and perceptions and continues as a vicious cycle. Hence to summarize, cognition plays a crucial role in this vicious cycle and so this cognition is targeted in the intervention.(Freeman, Pretzer, Fleming and Simon, 1990).

Case History

Amrita V, is a 25 year old female, single, a fashion designer by profession, working in a leading multinational company for almost 6 months. She is the second daughter of her parents of a middle class Malayalam joint family in Cochin. She came to Bangalore 6 years ago to study fashion technology and currently was staying as a paying guest in Bangalore. Amrita came with the chief complaints of lonely feeling, fatigue, sadness, feeling like crying all the time, lack of pleasure in everything and feeling that nobody understands her, for last 6 months, with unknown precipitating factor, onset being insidious, continuous course and deteriorating progress.

Family history revealed depression and suicidal attempts of her elder sister who is currently under medication. Educational history revealed, Amrita was an above average performer in her studies and had few friends in school and college. Her parents wanted her to study B.Com but she wanted to study Fashion Technology. Her parents were not happy with her preference for studying fashion technology, as according to them that was not a “good” profession for a “girl” to choose. However, with much difficulty and heated exchanges between her parents and her, Amrita convinced her parents and shifted to Bangalore 6 years back (in 2007) to pursue her studies in fashion technology. Her occupational history reveals that Amrita got her first job in Chennai where she worked for 2 months and then she shifted to Bangalore and worked in a leading company for 2 years. However, she was not satisfied with her work profile. As reported by her, Amrita started feeling depressed and had difficulty to concentrate in her work and other daily activities. She used to cry often and felt lonely. She finally decided to resign and observed that her condition improved gradually within few weeks in 2012. Amrita got the present job, 6 months back in a leading fashion organization and was happy with her profile. However, she observed that she was not able to “connect” with her present colleagues and/or other people. She felt lonely often, cried often, and also felt, that she was not capable of doing anything. Amrita’s premorbid personality revealed that she was shy yet responsible, motivated and had social relationships with friends and family. However, she had a distant relationship with her parents, as according to Amrita, her parents were very “dominating” and they always wanted to take all the decisions of her life. The relationship became more distant with her parents when she chose to shift to Bangalore for studying fashion technology instead of what her father wanted her to study.

Mental Status Examination (MSE) revealed appearance being well kempt and tidy, eye contact maintained, rapport could be easily established as attitude towards the examiner was cooperative, speech was spontaneous, relevant, coherent and goal directed. Cognitive functions revealed, attention could be easily aroused and sustained for an appreciable period of time, subjective and objective affect was depressed. Thought content revealed death wishes, helplessness and worthlessness with Grade VI (emotional insight) level of insight. Based on the chief complaints and Mental Status Examination, the provisional diagnosis of Moderate Depressive Episode with Somatic Syndrome (F32.11) was given (World Health Organization,1992).

Investigations and Assessments

Amrita first consulted the Psychiatrist for help, who referred her to a psychologist for psychotherapy. She was not given any medicines. Initially for the baseline assessment, Beck Depression Inventory (BDI) and Hamilton Depression Rating Scale (HAM-D) was given to Amrita. In both BDI and HAM-D the scores were in the moderate category. The Negative Automatic Thought (NAT) rating scale was also given for assessing the level of severity of her negative automatic thoughts. The score was found to be in the above average range.

Therapeutic program

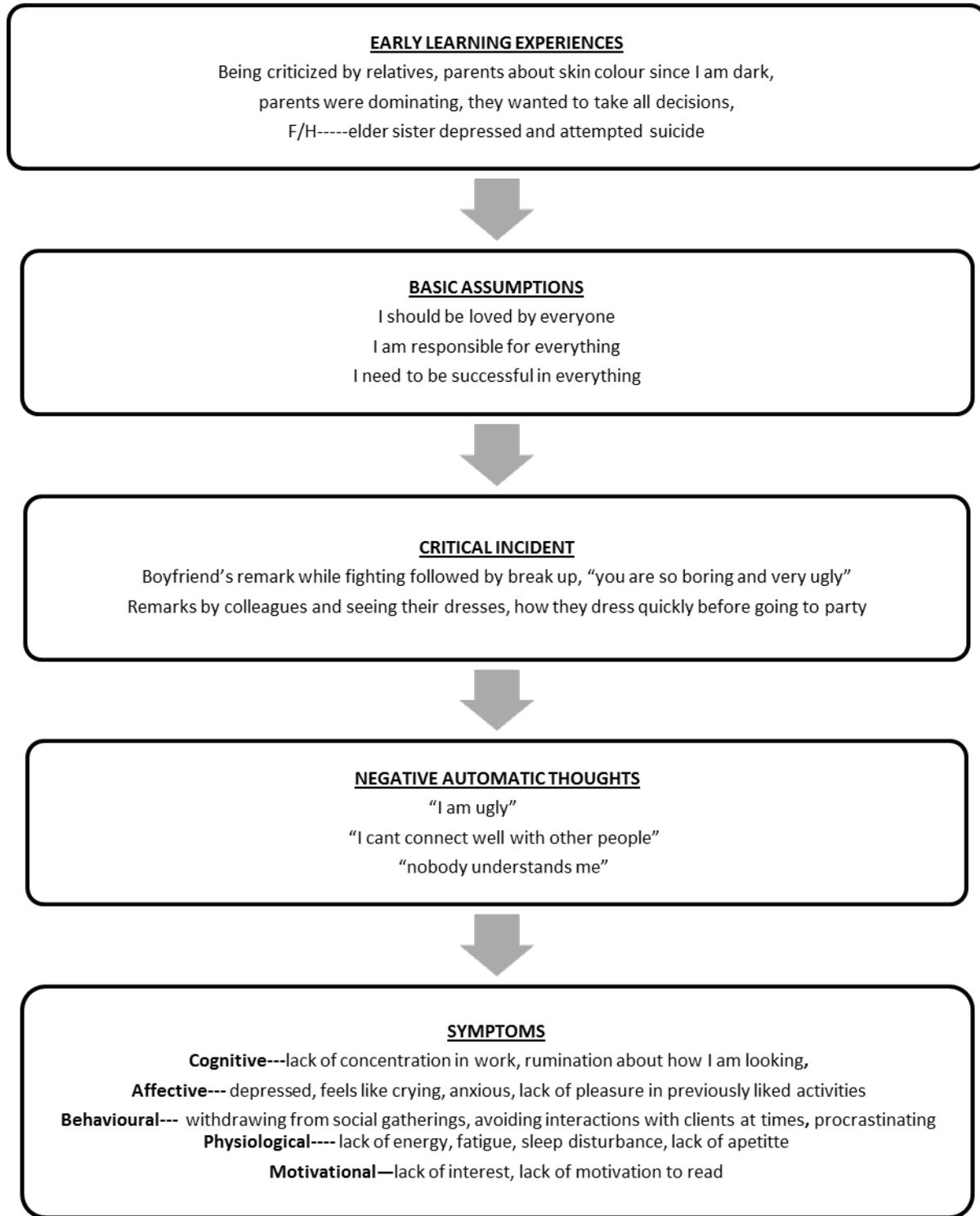
Cognitive Behaviour Therapy (CBT) was followed for Amrita. As mentioned earlier, that research shows the effectiveness of CBT in treatment of depression. The total number of session conducted were 9 with one hour duration of the sessions, once a week.

The goals of therapy were, to help Amrita in counteracting the negative cognitive biases, and develop a more balanced view of herself, the world, and the future. Target was also to restore the activity levels, by engaging her actively, as she mentioned that she had lost interest in previously liked activities of pleasure or achievement and help her in problem solving and decision making. The first task was to prepare a problem list and prioritise according to the severity, intensity and duration of the symptoms. Then it was to be followed by introducing the cognitive model and how the thoughts, feelings and behaviours are interconnected. The behavioural techniques were to be used for reducing of the symptom severity and then followed by the cognitive techniques. Further, the Thought diary for identifying and challenging the Negative Automatic Thoughts and followed by relapse prevention to be followed.

Psychopathology Formulation:

Based on the case history, MSE and self-reports of Amrita, the psychopathology formulation was done which is illustrated as follows—

Figure 2: Figure showing the Psychopathology Formulation:



Reference: Based on Beck's Cognitive Model of Depression.(Beck,1967,1976).

Initial phase---

A visual analogue scale ranging from 0 to 10 (with 0 indicating minimum distress and 10 indicating maximum distress) was used to assess the subjective level of distress of Amrita. This was used in every session, in order to obtain an idea regarding Amrita's affective condition. In the initial sessions, the

presenting complaints were reviewed, and the goal of the therapy were discussed, along with psycho-education regarding the nature of complaints, the source and course of the symptoms and its various manifestations. An overview of psychotherapy was presented, and the focus of therapy was explained. Also, the

nature of the sessions and the basic structure of sessions were discussed.

Amrita reported that she was unable to concentrate in her work as she tends to spend most of the day in ruminating about the distressing incidents. In order to cope with that, initially some distraction techniques like focussing on an object, sensory awareness, mental exercises and counting thoughts were briefed to Amrita. It was also briefed that these might act as a temporary way of distracting herself from thinking repeatedly about the incidents which were leading to increased distress rather than focussing on problem-solving. (Hawton, Salkovskis, Kirk, and Clark, 2001)

Amrita also reported that, since she spent most of her time in ruminating about the past and other distressing situations, she was having difficulty in engaging herself into any constructive work. As a result her performance in her work was also deteriorating day by day. Certain behavioural strategies were used in order to engage Amrita into some “mood-elevating” activities. This in turn would be helpful in challenging the negative automatic thoughts which in turn are forming as major obstacle in her engagement to any productive work. Amrita was asked to follow activity scheduling and mastery pleasure rating along with graded task assignment as homework. As a part of feedback in the following sessions, Amrita reported that these homework assignments helped her throughout the week to engage in something productive rather than simply sitting and ruminating about what happened. She also reported that she has improved a lot from before which was also depicted from the reassessments done and her subjective level of distress rating. Amrita expressed great happiness, and said that she felt almost fully cured. She was also praised at work for improvement in quality and was extremely happy.

Middle phase---

Since Amrita's condition improved from before, now the treatment sessions and homework assignments were directed towards teaching her to identify, question and test the negative automatic thoughts which form the core of cognitive therapy. This is also used to reduce the symptoms specific to the individual and later to help to cope with the distressing situations and engage in more constructive problem-solving. (Hawton, Salkovskis, Kirk, and Clark, 2001)

Amrita was explained how the negative automatic thoughts are a result of errors in processing of information. She was also briefed about how the perceptions and interpretation of the events, situations or experiences are distorted. Some of the cognitive distortions of Amrita, that were identified were overgeneralization, selective abstraction, personalization, dichotomous reasoning and arbitrary inference. (Hawton, Salkovskis, Kirk, and Clark, 2001)

The continuing relationship between thought, emotion, physiology and behavior was discussed with her. Examples were generated from her own experiences, to strengthen the understanding of the cycle.

This was followed by the introduction of the Dysfunctional Thought Record through homework, in order to help her in eliciting the Negative Automatic Thoughts (NATs) which might be causing the particular emotion and/or behaviour in her. (Hawton, Salkovskis, Kirk, and Clark, 2001)

Initially Amrita had difficulty in identifying the thoughts and differentiating them with her feelings. She could initially only identify the feelings and situations rather than the thoughts. However, she was helped during the therapy sessions. Guided discovery and Socratic questioning were followed in order to identify and challenge the negative automatic thoughts. (Hawton, Salkovskis, Kirk, and Clark, 2001) She was then able to identify herself and also was able to write the alternative thoughts for the negative thoughts.

Terminal phase of therapy---

In the terminal phase of the therapy, the reduction for the risk of relapse (De Maat, Dekker, Schoevers, & De Jonghe, 2006; Cuijpers et al., 2011a; Spielmans, Berman, & Usitalo, 2011) was aimed. CBT is also thought to be decreasing the vulnerability to future episodes by undermining the underlying assumptions on which depressive thoughts are based.

Identifying dysfunctional assumptions –

Amrita was in the stage of skilfully identifying and challenging the negative automatic thoughts so the focus of therapy was now shifted to dealing with the underlying dysfunctional assumptions. She was able to identify that whatever thoughts she was having are not reality and reported that “*I realized that there is something wrong in my thinking like this*”. Downward arrow technique (Hawton, Salkovskis, Kirk, and Clark, 2001) was used to identify her dysfunctional assumptions as “*I should be loved and liked by everyone*”, “*I need to succeed in everything*” and “*I should be strong*” etc. This identification made her realize the reason behind avoiding people, as she feared rejection from people. She was always striving towards meeting other people's expectations and also fear of failure and criticisms.

Challenging the dysfunctional assumptions was done by questioning and some behavioural experiments. According to Amrita the dysfunctional assumptions that were identified were not much helpful and illogical in nature. These were making her more sad and depressed and she is the one who is “suffering”. Further questioning revealed that, these assumptions mostly came from her experiences in childhood where she was constantly “taught” to please others by “behaving properly”. She also remembered, that in order to please others and be accepted by others she needs to be “fair” and “have an “attractive body built”, which according to her family members she did not have. She was criticised for her “darker skin tone” and a “slim body built”. She was often compared with her cousins and friends and was often told that she might not get a good groom if she does not have the “appropriate body and skin”. In order to challenge the assumptions Amrita was asked to formulate an alternative for these assumptions and write on flash cards for reading it repeatedly until acting in accordance with the alternative assumptions become as a habit for her. Also behavioural experiments were given as homework assignments, like, to gather information about other people's standards, observing what other people do and acting against assumptions and observing the consequences and testing out a new rule in action. (Hawton, Salkovskis, Kirk, and Clark, 2001)

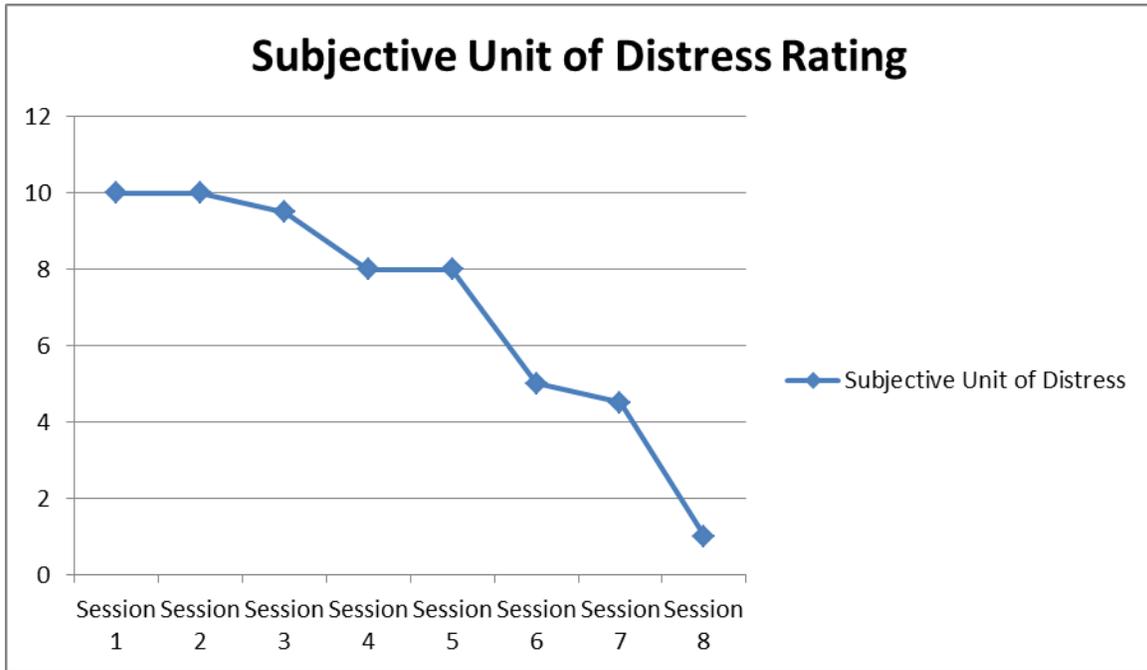
Reassessments corroborated with the reports of Amrita that she was feeling “better” and “good” She also said that she was

confident now to deal with the situations which she was finding it difficult before. She wanted to discontinue the therapy. However, she was reminded of follow up sessions and not to terminate the therapy abruptly. Though she agreed to turn up for the follow up sessions but did not turn up for them later, except for one follow up session.

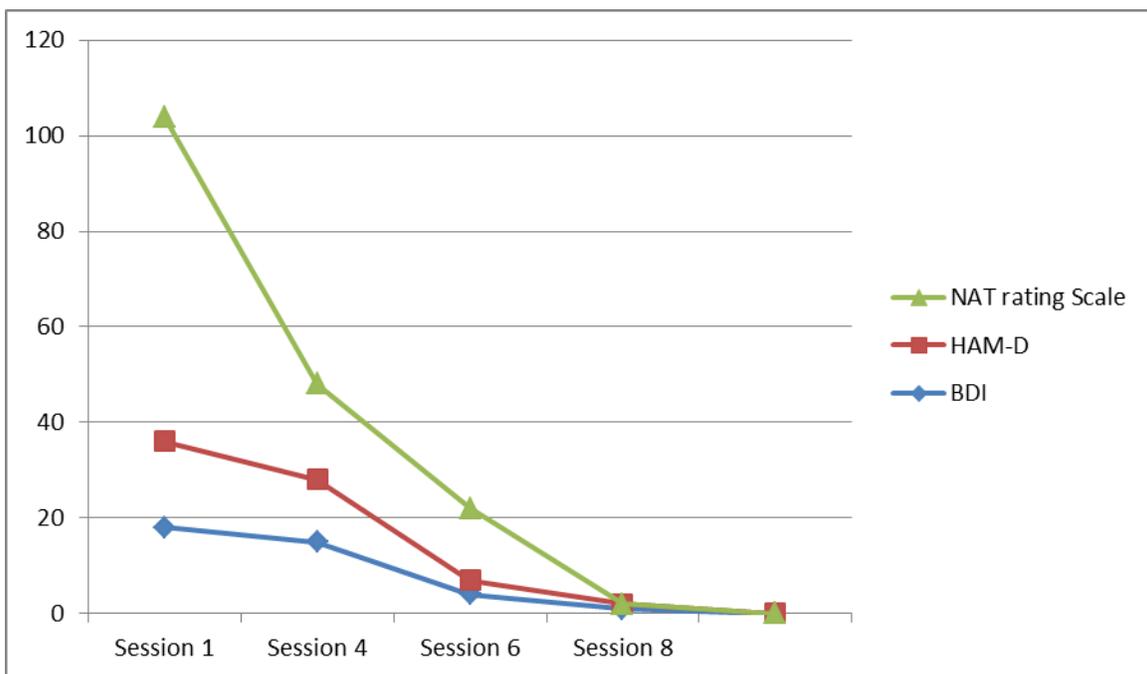
Outcome

The ratings given subjectively by Amrita, in each session, has been graphically represented below, to identify the alterations in the affect and experience of distress. The following graph represents the same:

Graph I: graphical representation of improvement of the client as assessed by visual analogue scale:



Graph II: Graphical representation of improvement through sessions as assessed by BDI, HAM-D and NAT rating Scale:



Therapist's Reflections

To reflect from a therapist's point of view, Amrita's level of insight and motivation was a great advantage; this evidently, is what brought her back to each session, in spite of her unsteady emotional states. Amrita also had the ability to identify & describe her negative thoughts vividly. With the progression of the therapy sessions, the awareness of her own negative emotions and thoughts was evident from the Dysfunctional Thought Record. She was also able to differentiate between her emotions and thoughts easily after a little support from the therapist.

Amrita's insight into her automatic thoughts, her ability to identify and distinguish her emotions from these thoughts along with her understanding regarding the use of her avoidance behaviour to cope with the situations, could be said to be the key features that helped in her progress. Her ability to focus and her optimism, about the outcome of the therapy truly helped in improvement in her condition. Her acceptance, that she must take the responsibility for change was evident in her verbal reports and her behaviour. She actively participated in the therapy sessions and her commitment could be inferred from the way she followed every single technique and completed her homework assignments. This also corroborates with the findings of a study done by Renaud, Russell and Myhr (2014), saying that a greater reduction in the illness symptoms was highly associated with clients having a greater capacity for participation in CBT. Also those patients who have the greater capacity to identify and articulate their thoughts and feelings and to share them in a "nondefensive, focused way" benefit most from CBT. (Renaud, Russell and Myhr, 2014).

The therapeutic relationship or the bond that was formed could be said to have had its impact on her engagement in her tasks and be focussed on the therapeutic goals. These also might have enabled her to feel "safe" with the therapist. The trust that she had with the therapist was often verbalized by her- "*I am speaking to my heart's content after a long time...*" "*I am also not close to anybody in my family with whom I can talk or discuss...*"

The empathy from the therapist's side, also might have played its role in the improvement of her condition, corroborating with the findings of a study done by Burns and Nolen-Hoeksema (1992). The study stated that therapeutic empathy and homework compliance especially structured by experienced therapists had a moderate-to-large causal effect on recovery from depression (aged 18-75 years) treated with cognitive-behavioural therapy (CBT). The therapeutic alliance is also a significant factor with significant influence on outcome. (Krupnick, Sotsky, Simmens, Moyer, Elkin, Watkins, and Pilkonis, (1996).

If reflected on the first two sessions Amrita had weeping spells. However, in the third session she did not cry. However, by that time, no formal introduction of cognitive restructuring was done. This betterment in her condition in such an early stage of the therapy, might be explained in the following way. As inferred from the findings of previous studies, that many "nonspecific" factors like treatment rationale and the assignment of homework, play a significant role in ameliorating the patient's negative feelings, especially hopelessness, in the initial phase of the treatment sessions. These factors often "catalyse" the improvement across the depressive symptoms. Thus, before any

proper introduction of formal cognitive restructuring occurs, improvement in intensity, frequency and duration of symptoms occurs in most of the cases. (Ilardi and Graighead, 1994).

Though she was psycho educated in the very first session about the booster or follow up sessions, she did not turn up for more than one session. She was given a call from the clinic but she did not pick up the call. She also did not call back the clinic, which she usually did whenever; she missed a call from the clinic. In the terminal phase of the treatment sessions, she mentioned that her office was about to shift to a different place which was quite far from the clinic. Previously both her office and her house were very near to the clinic. May be that prompted her to discontinue, as it might have had become difficult for her to travel or manage time. If reflected on other reasons about her discontinuity to the booster sessions, could be, that she was able to "manage" herself and she has become "confident" to handle the stresses or the situations were not perceived to be so "stressful" as before; which could be due to the way she has learned to reconstruct her thoughts.

Though Amrita terminated the therapy sessions prematurely, was quite compliant on the homework assignments and other self-help tasks. This is unlike other studies which stated that patients who terminated therapy prematurely were less likely to complete the self-help assignments between sessions. (Burns and Nolen-Hoeksema (1992). However, previous literature suggests that psychotherapy when compared to pharmacotherapy has superior results and lower relapse rates. (De Maat, Dekker, Schoevers, & De Jonghe, 2006; Cuijpers et al., 2011a; Spielmans, Berman, & Usitalo, 2011). "Psychotherapy had a significantly lower rate of relapse (26.5%) than did pharmacotherapy (56.6%). Additionally, when examining attrition from pharmacotherapy (n = 182) and psychotherapy (n = 140), the drop-out rate was 28.4% for pharmacotherapy versus 23.6% for psychotherapy. This difference was statistically significant, indicating dropout rates are significantly lower in psychotherapy than pharmacotherapy." (Hunsley, Elliott, and Therrien, 2013).

II. CONCLUSION

Keeping in line with the previous literature, in the present case study also, Cognitive Behaviour Therapy proved to be an effective treatment of depressive symptomatology. However the question of premature termination or drop out of the client for the follow up sessions remains unanswered. So, is it the efficacy of the of the treatment sessions; was the sessions sufficient enough to make her insightful that she did not turn up or that made her confident enough that she is able to deal with the demands of the situations and/ or is it that the symptoms have subsided and are not manifested as yet to seek help?

ACKNOWLEDGEMENTS

I Thank Dr. Yesheswini Kamaraju, , Preethi Balan, The Reach Clinic and Ananya Sinha for their support and valuable comments that greatly improved the manuscript.

REFERENCES

- [1] Amin, G., Shah, S. and Vankar, G.K.(1998). The prevalence and recognition of depression in primary care. *Indian J Psychiatry*,40,364–39.
- [2] Beck, A.T. (1967). *Depression: Clinical, experimental and theoretical aspects*. Harper and Row, New York.
- [3] Beck, A.T. (1976). *Cognitive Therapy and the Emotional Disorders*. New York: International Universities Press.
- [4] Beck, A.T., Rush, A.J., Shaw, B.F. and Emery, G. (1979). *Cognitive therapy of depression*. Guilford Press, New York.
- [5] Blatt, S. and Zuroff, D. (1992). Interpersonal relatedness and self definition: Two prototypes for depression. *Clinical Psychology Review*,12, 527-562.
- [6] Bromet E., Andrade L.H, Hwang I., Sampson N.A., Alonso J. and de Girolamo G., et al. (2011) Cross-National Epidemiology of DSM-IV Major Depressive Episode, *BMC Med*, 9, 90.
- [7] Burns, D. D. and Nolen-Hoeksema, S. (1992). *Journal of Consulting and Clinical Psychology*, Vol 60(3), 441-449.
- [8] Carr, A.(1991). Milan Systemic Family Therapy: A review of 10 empirical investigations. *Journal of Family Therapy*, 13,237-264.
- [9] Carr, A. (1999).*The Handbook of Child and Adolescent Psychology:A contextual Approach*. Brunner-Routledge. New York.
- [10] Cuijpers, P., Andersson, G., Donker, T., & Van Straten, A. (2011a). Psychological treatment of depression: Results of a series of meta-analyses. *Nordic Journal of Psychiatry*, 65, 354-364.
- [11] De Maat, S., Dekker, J., Schoevers, R., & De Jonghe, F. (2006). Relative efficacy of psychotherapy and pharmacotherapy in the treatment of depression: A metaanalysis. *Psychotherapy Research*, 16, 566-578.
- [12] Deakin, J. (1986). *The Biology of Depression*.London:Royal College of Psychiatry.
- [13] Derasari, S. and Shah, V.D.(1988). Comparison of symptomatology of depression between India and U.S.A. *Indian J Psychiatry*,30,129–34.
- [14] Driessen, E., Hollon and Steven, D. (2010). Cognitive Behavioral Therapy for Mood Disorders: Efficacy, Moderators and Mediators. *Psychiatric Clinics of North America* 33(3), 537–55.
- [15] Freeman, A., Pretzer, J., Fleming, B. and Simon, K.M. (1990).*Clinical Applications of Cognitive Therapy*.
- [16] Goldberg, D.P. and Lecrubier, Y. (1995). Form and frequency of mental disorders across centers. Mental illness in general health care: An international study. In: Ustun TB, Sartorius N, editors. Chichester: John Wiley and Sons on behalf of the World Health Organization. pp. 323–34.
- [17] Grant, B.F. (1995). "Comorbidity between DSM-IV drug use disorders and major depression: Results of a national survey of adults". *Journal of Substance Abuse*, 7 (4), 481–87.
- [18] Harrington, R. (1993). *Depressive disorder in childhood and adolescence*. Chichester:Wiley.
- [19] Hawton, K., Salkovskis, P.M., Kirk, J. and Clark, D.M.(2001). *Cognitive Behaviour Therapy for Psychiatric Problems: A practical Guide*. Oxford University Press.
- [20] Hunsley, J., Elliott, K. and Therrien, Z. (2013). *The Efficacy and Effectiveness of Psychological Treatments*.University of Ottawa. Canadian Psychological Association.
- [21] Husain N, Creed F, Thompson B. (2000). Depression and social stress in Pakistan. *Psychological Medicine*.Vol 30, 395–40235.
- [22] Ilardi, S.S. and Craighead, W.E. (1994).The Role of Nonspecific Factors in Cognitive-Behavior Therapy for Depression.*Clinical Psychology: Science and Practice*.Vol 1, (2), 138–15.
- [23] Kazantzis, N., Beck, J.S., Dattilio, F.M., Dobson, K.S. and Rapee, R.M. (2013). Collaborative Empiricism as the Central Therapeutic Relationship Element in CBT: An Expert Panel Discussion at the 7th International Congress of Cognitive Psychotherapy. *International Journal of Cognitive Therapy: Vol. 6, No. 4*, pp. 386-400.
- [24] Kessler, R.C., Nelson, C.B., McGonagle, K.A., Liu, J., Swartz, M. and Blazer DG (1996). "Comorbidity of DSM-III-R major depressive disorder in the general population: results from the US National Comorbidity Survey". *British Journal of Psychiatry*. 168 (suppl. 30), 17–30.
- [25] Krupnick, J. L., Sotsky, S.M., Simmens, S., Moyer, J., Elkin, I., Watkins, J. and Pilkonis, P.A.(1996). The role of the therapeutic alliance in psychotherapy and pharmacotherapy outcome: Findings in the National Institute of Mental Health Treatment of Depression Collaborative Research Program. *Journal of Consulting and Clinical Psychology*, Vol 64(3), 532-539.
- [26] Kupfer, D. and Reynolds, C. (1992). Sleep and affective disorders. In E.Paykel (ed.), *Handbook of Affective Disorders* (second edition, pp. 311-323), Edinburgh: Churchill Livingstone.
- [27] Levy, S. and Heiden, L. (1991). Depression, distress and immunity: Risk factors for infectious disease. *Stress Medicine*, 7,45-51.
- [28] Lewinsohn, P., Clarke, G., Hops, H. and Andrews, J. (1990). Cognitive behavioural treatment for depressed adolescents. *Behaviour Therapy*, 21, 385-401.
- [29] Mirowsky, J. and Ross, C.E. (1992). Age and depression. *J Health Soc Behav.* 33, 187–205.
- [30] Murphy, J.M., Laird, N.M., Monson, R.R., Sobel, A.M. and Leighton, A.H. (2000). A 40-year perspective on the prevalence of depression: The Stirling County Study. *Arch Gen Psychiatry*, 57, 209-15.
- [31] Nandi, D.N., Banerjee, G., Mukherjee, S.P., Ghosh, A., Nandi, P.S. and Nandi, S.(2000). Psychiatric morbidity of a rural Indian community changes over a 20 year interval. *British Journal of Psychiatry*, 176, 351–6.
- [32] Nolen-Hoeksema, S. and Stanford, C.A. (1990). *Sex Differences in Depression*. Stanford University Press.
- [33] Poongothai, S., Pradeepa, R., Ganesan, A., Mohan, V.(2009). Prevalence of depression in a large urban South Indian population - The Chennai Urban Rural Epidemiology Study (CURES-70). *PLoS One*, 4, E7185.
- [34] Pothan, M., Kuruvilla, A., Philip, K., Joseph, A. and Jacob, K.S.(2003). Common mental disorders among primary care attenders in Vellore, South India: Nature, prevalence and risk factors. *Int J Soc Psychiatry*,49, 119– 25.
- [35] Powell, V.B., Abreu, N., Oliveira, I.R. and Sudak, D. (2008). *Cognitive Behaviour Therapy for Depression*. *Brazilian Journal of Psychiatry*. 30,(2).
- [36] Reddy, M.S.(2010). Depression: The disorder and the burden. *Indian Journal of Psychological Medicine*, Vol 32, No.1,1-2.
- [37] Remick, R.A.(2002). Diagnosis and management of depression in primary care: a clinical update and review. *CMAJ*, 167,53-60.
- [38] Renaud, J., Russell, J.J. and Myhr, G. (2014). Predicting Who Benefits Most From Cognitive-Behavioral Therapy for Anxiety and Depression. *Journal of clinical psychology*.
- [39] Sadock, B.J. and Sadock, V.A.(2007). Mood disorders. In: Kaplan & Sadock's Synopsis of Psychiatry. Lippincott Williams & Wilkins. 10(Ed), 527-78.
- [40] Seligman, M. (1981). A learned helplessness point of view. In Rehm (ed.),*Behaviour Therapy for Depression*. New York: Academic, pp.123-141.
- [41] Spielmann, G. I., Berman, M. I., & Usitalo, A. N. (2011). Psychotherapy versus second-generation antidepressants in the treatment of depression: A meta-analysis. *The Journal of Nervous and Mental Disease*, 199, 142-149.
- [42] Thomas, M. and Drake, M. (2012). *Cognitive Behaviour Therapy Case Studies*. Sage Publications Inc.
- [43] Tolin, D.F. (2010). Is cognitive-behavioral therapy more effective than other therapies? A meta-analytic review. *Clinical Psychology Rev.* 30 (6), 710-20.
- [44] Wehr, T. and Rosenthal, N. (1989). Seasonality and affective illness. *American Journal of Psychiatry*, 146,829-839.
- [45] Westbrook, D., Kennerley, H. and Kirk, J. (2011).*An Introduction to Cognitive Behaviour Therapy: Skills and Applications*, (second edition), Sage Publications Ltd.
- [46] Williams, J. (1992). *The Psychological Treatment of Depression:A guide to the Theory and Practice of Cognitive Behaviour Therapy* (second editon). London: Routledge.
- [47] Whitfield, G. and Williams, C. (2003).The evidence base for cognitive-behavioural therapy in depression: delivery in busy clinical settings. *Royal College of Psychiatrists. B.J. Psych Advances*. 9,(1).
- [48] W.H.O: World Health Organization. *The ICD–10 Classification of Mental and Behavioral Disorders*. Geneva: WHO, 1992.

AUTHORS

First Author – Angana Mukherjee, Clinical Psychologist, M.A.(Specialization-Clinical Psychology), M.Phil in Clinical

Psychology, (Department of Psychology, University of Calcutta,
RCI Reg No.A28069,The Reach Clinic, Koramangala,
Bangalore, India., Email--anganamukherjee6@gmail.com

Correspondence Author – Angana Mukherjee, Email—
anganamukherjee6@gmail.com, Ph- +91-9739087734.

The Effect of Arsenic on Liver Tissue of Experimental Animals (Fishes and Mice) - A Review article

Kidanemariam Gaim*, Girmay Gebru**, Sunday Abba*

* Department of Anatomy Institution of Biomedical sciences Mekelle University Ethiopia

** Department of Anatomy, College of Health Science, School of Medicine Addis Ababa University Ethiopia

Abstract- Toxic metals are widely found in our environment and are mainly caused by the use of the pesticides, industrial activities and mining operations. One of them is arsenic that accumulates in the liver tissue to toxic levels and cause changes in the activities of several liver enzymes and cellular damage. Enzymes like aspartate aminotransferase and alanine aminotransferase are found predominantly in liver tissue and cellular damage as a result of arsenic exposure releases these enzymes into the blood stream and the plasma levels of these enzymes indicate hepatotoxicity. The objective of this project is to review the several research works on the effect of arsenic on liver tissue of fishes and rats at different time of exposure. The resources used for this review were obtained from published work in several peer review journals. ALT activity has shown an increase of 6.03%, 13.61% and 27.75% at different doses of exposure and the AST has shown also an increase of 9.04%, 16.32% and 38.08% at different doses in fishes. The GDH activity has shows an increased level of 9.61%, 23.72% and 34.62% at different doses when compared to control groups of fishes. Varied degrees of changes (mild to severe) were also observed in groups of fishes and mice exposed to different doses of arsenic and results in necrosis of the hepatocytes, central vein and sinusoidal spaces expansion due to shrinkage. Other result has shown that fish exposed to different concentrations of NaAsO_2 have shown varied degrees of changes i.e. death in high concentration; however, as the concentrations decreased, the survival period increased gradually. The FTIR spectra revealed also significant differences in absorbance intensities in the amide bands between control and arsenic intoxicated liver tissues. Among the results reported most of which have shown increment and some of them have shown decrement when compared to the control groups up on the exposure of different concentration of arsenic i.e. (28.30 mg/L of arsenic trioxide (As_2O_3), 4.2 mg/kg sodium arsenate, (96 ug/L, 144 ug/L), 1/10 LC50 of As, 1/20 LC50 of As, 75mg/L arsenic trioxide (As_2O_3), (0.5,0.1 and 0.2mM of NaAsO_2) and (41.5 ppb) of As_2O_3 . Eventually, Arsenic administration increased serum AST and ALT activities of fishes reflecting a situation of tissue damage. This indicates that ALT and AST can be used as biomarkers of cellular damage in blood plasma, protein degradation and liver damage. In all the investigations various activities of arsenic on the enzymes may be related to the arsenic concentration, duration of the exposure, species differences and the methodology used

Index Terms- Fishes, Mice, hepatotoxicity, Toxic, Metal

I. INTRODUCTION

Toxic metals are widely found in our environment and humans are exposed to these metals from numerous sources, including contaminated air, water, soil and food; several studies have indicated that metals, such as lead, arsenic, cadmium, mercury and others deplete cells major antioxidants and enzymes; toxic metals mentioned above cause an increase in production of reactive oxygen species (ROS) such as hydroxyl radical (HO), superoxide radical (O_2^-) or hydrogen peroxide (H_2O_2) (1). Here we intend to review the extent of toxicity of arsenic on liver tissue of Mice, Rats and Fish at different times as indicated in various research works.

Non-degradable heavy metals are regarded as hazardous to aquatic ecosystems because of their environmental persistence and their tendency for bioaccumulation. Different species of elements can exert diverse toxicological effects in animal and human system and it has been reported that heavy metals affect various biochemical parameters of the fish liver (2).

Arsenic, one of these heavy metals is a naturally occurring metalloid with atomic number 33 located on Group V of the periodic table. It exists in four oxidation states: -3, 0, +3, and +5. The more commonly known arsenic compounds are arsenate and arsenite (3)(4). Arsenic occurs as two allotropic forms, yellow and metallic gray. The metallic gray form is the stable form under ordinary conditions (3). Arsenic is a protoplasmic poison due to its effect on sulphhydryl group of cells interfering with cells, enzymes, cell respiration and mitosis (2).

It has been reported that exposure to arsenic is via drinking water, air, food and beverage in many places in the world and exposure through drinking water is increasing due to contamination from industrial operation and over withdrawal of ground water for irrigation (5)(2). Exposure to high levels of arsenic through drinking water has been recognized for many decades in some regions of the world, i.e. China, India, and some countries in Central and South America (4).

Arsenic is a metalloid that is widely found in water, soil, air and also usually found in the environment combined with other elements such as oxygen, chlorine and sulfur. Arsenic combined with these elements is called inorganic arsenic and arsenic combined with carbon and hydrogen is referred to as organic arsenic. Organic arsenic is usually less harmful than the inorganic forms (3).

Arsenic in drinking water is typically inorganic and can be present either as $\text{As}+3$ (arsenite) or $\text{As}+5$ (arsenate). In Bangladesh, arsenic in the ground water is primarily in the $\text{As}+3$ form and is more cytotoxic and genotoxic than $\text{As}+5$ (6). The

Legal limits of arsenic vary between 0.1 mg kg⁻¹ (Venezuela) and 10 mg kg⁻¹ (Hong Kong), in addition the Joint world health organization expert Committee (1983) has also set a limit of 0.1mg kg⁻¹ or 10 parts per billion (ppb); however, in some countries this norm is related to the total arsenic concentration, whereas in other countries it expresses the inorganic arsenic fractions; therefore the meaning of these norms is not straightforward (7)(3)(8). A decreasing toxicity order can be set as: arsenite - arsenate - dimethylarsinic acid - monomethylarsonic acid - arsenobetaine - arsenocholine - trimethylarsine oxide (8). Individuals who accumulate the trivalent intermediates are thought to be at greater risk of arsenic-induced diseases (6).

Arsenic level found in marine organisms are much higher than those found in terrestrial organisms thus an important question relates to the ability of marine organisms to concentrate arsenic (9)(8). Therefore fishes are usually considered as organism of choice for assessing the effects of environmental pollution on aquatic ecosystem and the body blood parameters of the fish have been used as indicators of environmental risk and also, the assay of the enzymes activities aspartate aminotransferase (AST), alanine aminotransferase (ALT) & lactate dehydrogenase (LDH) in the blood and tissues of the fish frequently used as a diagnostic tool in human and animals (9). Arsenic toxicity is associated with the formation of reactive oxygen species, which may cause severe damage to several biological systems and based on these studies, it is hypothesized that these metals could also accumulate in the liver to toxic level and cause pathological alterations (10).

Arsenic contamination is mainly caused by the use of the arsenic pesticides, industrial activities and mining operations (1). Due to increasing levels of arsenic in the ground water in Bangladesh and West Bengal considerable attention has been given to the study of the effect of arsenic on human beings and selected mammals (11). Continuous exposure of freshwater organisms to low concentrations of heavy metals may result in bioaccumulation, causing changes in the activities of several liver enzymes. In addition fish as living bio indicator species play an increasingly important role in monitoring of water pollution because they respond with great sensitivity to changes in the aquatic environment (12).

II. THE LIVER AS A TARGET ORGAN FOR METABOLISM

Most ingestible substances are ultimately taken up to the liver for metabolic activities. This exposes the liver to several toxicity. Toxic metals are widely found in our environment and are mainly caused by the use of the pesticides, industrial activities and mining operations. One of them is arsenic that accumulates in the liver tissue to toxic levels and cause changes in the activities of several liver enzymes and cellular damage. Enzymes like aspartate aminotransferase and alanine aminotransferase are found predominantly in liver tissue and cellular damage as a result of arsenic exposure releases these enzymes into the blood stream and the plasma levels of these enzymes indicate hepatotoxicity. A number of researches have been conducted concerning the effect of arsenic on the liver tissue of fishes and mice by various investigators in different

species in response to variable doses of arsenic and time of exposure and are presented as follows:- for example Serum ALT level of *Labeo Rohita* species of fish exposed to 28.30 mg/L arsenic trioxide has shown an activity of 641.18 IU/L at 24 h and 798.11 IU/L at 96 h exposure and from the control 487.25 IU/L at 24 h and 399.7 IU/L at 96 h, was recorded respectively. Similar trends were also observed in serum AST of fish exposed to arsenic that has shown an activity of 1532.77 IU/L at 24 h and 1622.39 IU/L at 96 h exposure and from the control has shown 1085.72 IU/L at 24 h and 861.58 IU/L at 96 h, respectively. These results indicated that arsenic toxicity increase the level of liver enzymes of fish (*Labeo rohita*) upon the exposure of the same dose of arsenic as the time of exposure increase(10)

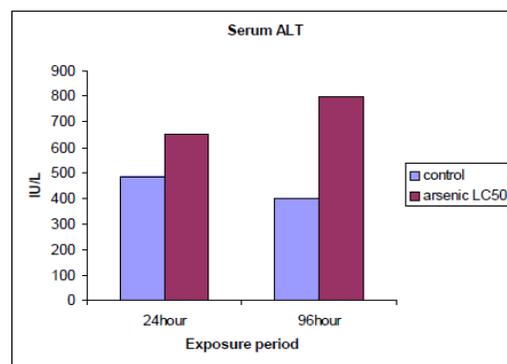


Figure 1: The toxic effect of arsenic trioxide (28.30 mg/L) on the ALT activity of *Labeo rohita* at the end of 24 and 96 h exposure periods (P<0.01)

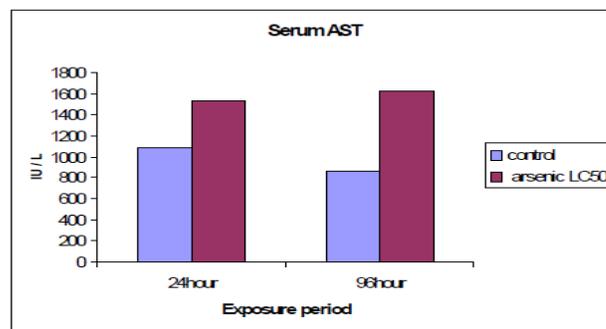


Figure 2: The toxic effect of arsenic trioxide (28.30 mg/L) on the AST activity of *Labeo rohita* at the end of 24 and 96 h exposure periods (P<0.01)

Similarly, Devaraju *et al.* have pointed out that administration of sub lethal dose of sodium arsenate i.e. 4.2 mg/kg/body weight was given to albino mice as single, double and multiple doses at stipulated period i.e 3rd, 5th and 9th days respectively. Isolated liver tissue for enzymes analysis and histopathological has shown that; the alanine amino transferease (ALT) activity has shown an increase of 6.03% in single dose, 13.61% in double dose and 27.75% in multiple doses. The activity level of aspartate amino transferase (AST) has shown an elevation of 9.04% in single, 16.32% in double and 38.08% in multiple dose when compared to control. The glutamate dehydrogenase (GDH) activity has shown an increased level of 9.61% in single, 23.72% in double and 34.62% in multiple doses when compared to control and results Severe pathological

changes in all dose of sodium arsenate such as necrosis of hepatocytes, nuclear degeneration and vacuoles(12) as shown in table1 and figure A – E

Table 1; alterations in alanine and aspartate aminotransferases and glutamate dehydrogenase activity levels in liver tissue of sodium arsenate treated albino mice

Name of enzymes	Single dose		Double dose		Multiple dose	
	Control	Experiment	Control	experiment	Control	experiment
ALT (uMoles of pyruvate formed/mg protein/hr	1.492±0.033	1.582±0.044 (6.03)	1.510±0.032	1.695±0.023 (13.61)	1.498±0.029	1.906±0.029 (27.75)
AST(umoles of pyruvate formed/mg protein/hr	1.305±0.027	1.423±0.044 (9.04)	1.312±0.026	1.520±0.029 (16.32)	1.308±0.025	1.802±0.023 (38.08)
GDH(umoles)	0.156±0.020	0.171±0.031 (9.61)	0.158±0.025	0.193±0.024 (23.72)	1.160±0.022	0.210±0.013 (34.62)

Values in parenthesis indicate the percentage change over control
 Values are mean ±SD. Of six separate observation

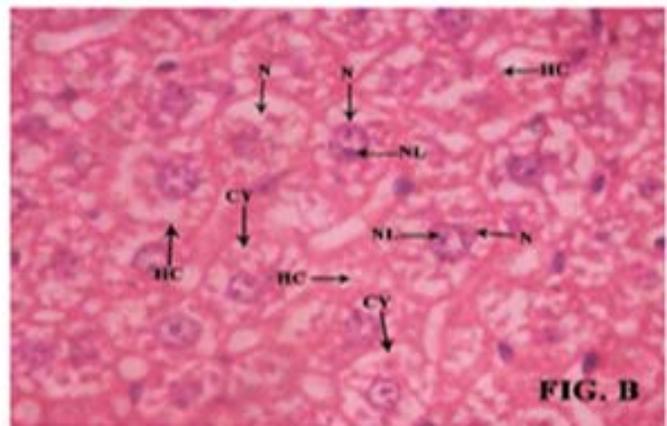
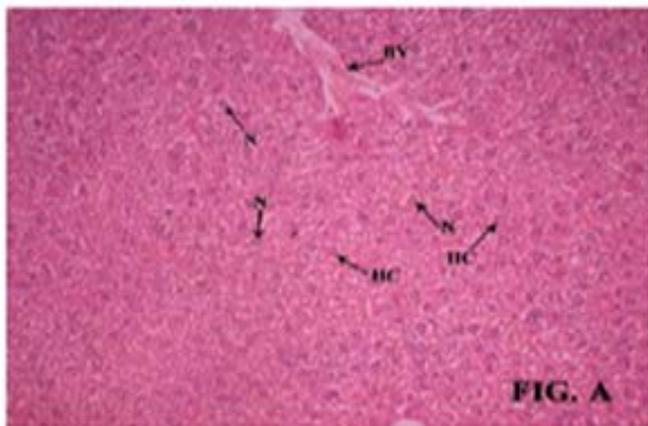


Fig.A: Mice Liver showing hepatocytes (HC) with centrally placed nucleus – H & E. 100 X.

Fig.B.The mice liver under single dose did not show significant pathological changes with one or more nucleoli (NL) and cytoplasm (C)-H & E.400 X.

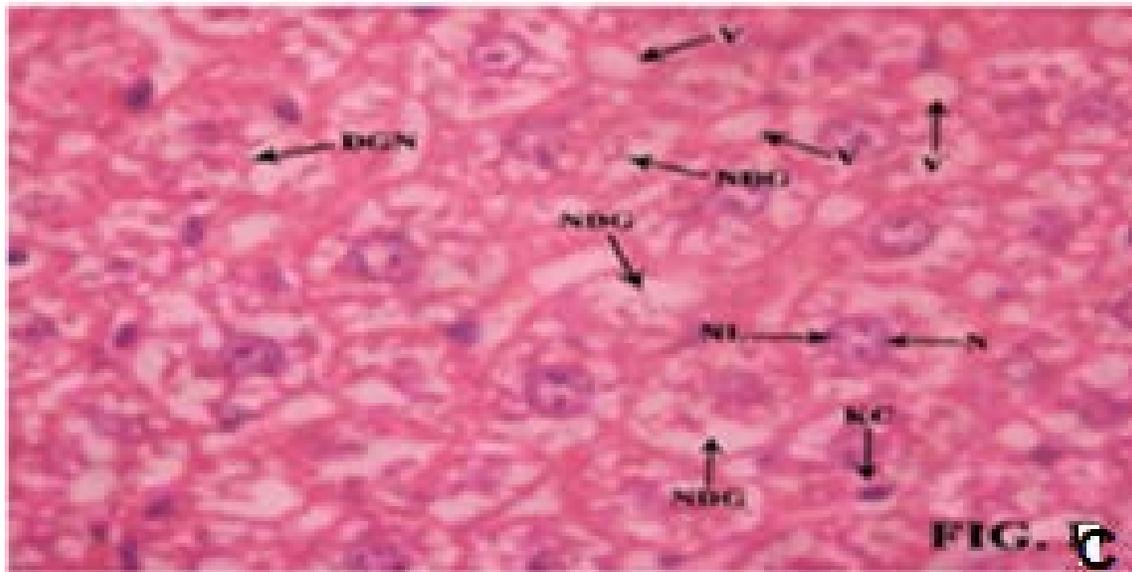
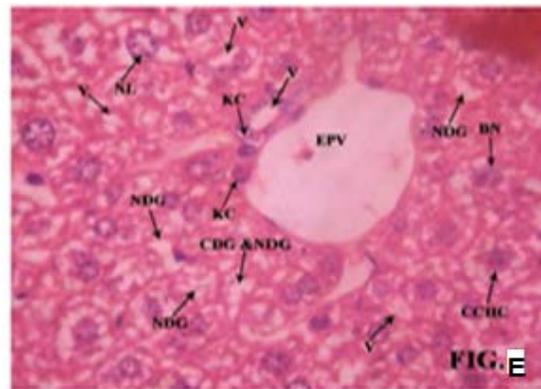
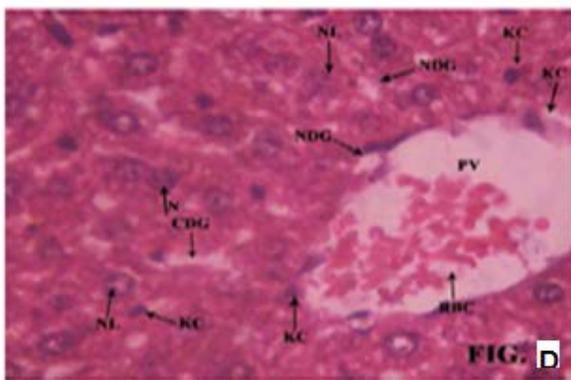


Fig.C: Mice liver under double dose of sodium arsenate showing nuclear degeneration (NDG) and appearance of vacuoles (V) in hepatocytes – H & E. 400 X.



Figs. D & E: Mice liver under multiple dose of sodium arsenate showing few RBC in portal vein (PV), nuclear degenerative changes (NDG) and cytoplasmic degenerative changes in cytoplasm (CDG), emptied portal vein (EPV), appearance of severe necrosis in cytoplasm (NCC),

Significant decrease in all enzymatic activity was observed in the liver of the juvenile *Labeo rohita* exposed to the concentration of arsenic (144 µg/L) and (96 µg/L) for one month period of exposure, and results in the disturbance in the structure and integrity of cell organelles, like ERC and membrane transport system. But the decrement was not significant at the lower concentration (11) as shown in table2.

Table 2; Enzyme activities in the Liver of *Labeo rohita* after exposure to arsenic, activity is expressed as µMoles pyruvate formed per mg protein in 30 minutes

Labeo rohita Groups	Arsenic conc. (µg/l)	GOT µMpyruvate formed in 60minutes	GPT µM pyruvate formed in 30 mins	ACP µM pyruvate formed in 30mins	ALP µM pyruvate formed in 30mins
Control	0	19.44±3.34	9.50±3.29	0.27±0.14	0.76±0.31
First Group	96	18.46±4.15	6.91±1.10	0.07±0.01	0.74±0.07
Second Group	144	13.09±6.46	1.88±1.29	0.04±0.06	0.64±0.05

GOT; glutamate oxaloacetate transaminase; GPT; glutamate pyruvate transaminase; ACP; acid phosphatase; ALP; alkaline phosphatase

According to the investigation reported by Allah and Hameid, in 2009 the plasma levels of aspartate aminotransferase (AST), alanine aminotransferase (ALT) in the *Clarias gariepinus* (a specie of fish) exposed to 1/10 LC50 and 1/20 LC50 of arsenic for 20 days were significantly increased and this report indicated that as the dose of arsenic increases it leads to varied degree of liver cell damage such as shape deformation, vacuolization, enlargement, necrosis and degeneration of hepatocyte. As shown in Table 3 and figure F

Table 3; Changes in the activities (Units/min/g fresh tissue) of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) in the liver tissue of the Nile cat-fish (*Clarias gariepinus*) exposed to two levels of arsenic (As) for 20 days.

Groups	AST	ALT
Control	48.432±5.121	40.592±6.927
1/10 LC50 of As	65.513±4.152	62.692±4.212
1/20 LC50 of As	58.724±5.136	51.937±5.214

The data are expressed as mean of fish's ±standard deviation. (P<0.05) indicate significant differences from the control.

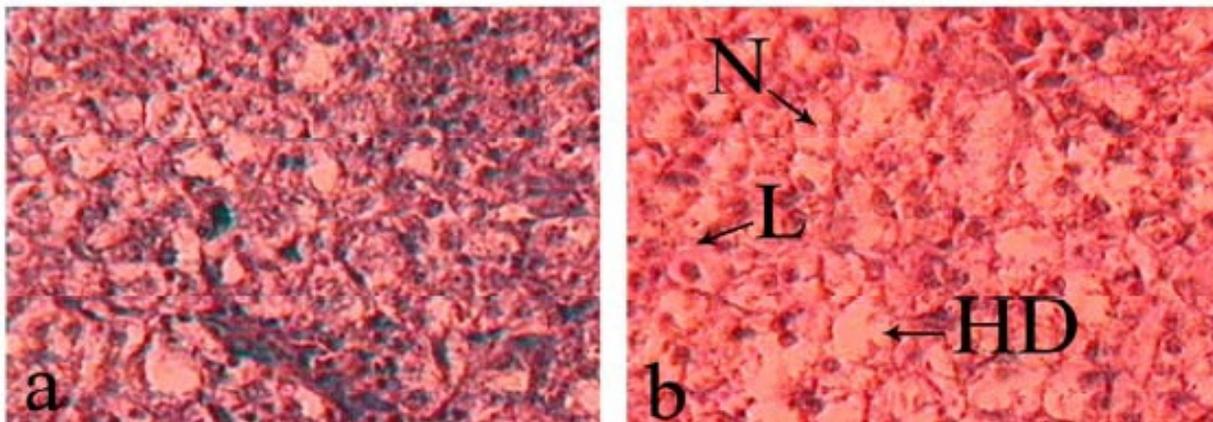


Figure F. Photomicrograph of the liver section of *Clarias Gariepinus* stained with haematoxylin and eosin (400X): (a) Fish exposed only to water (control); b) Fish exposed to 1/10 LC50 of As, showing necrosis (N), enlarged hepatocyte (L) and hepatocyte degeneration (HD).

Ferzand *et al.*, in 2008 have reported that varied degrees of change (mild to severe) were observed in 30, 150 and 300 ppb arsenic exposed groups for 40 days and results various pathological changes such as Necrosis of hepatocytes, central vein, cytoplasmic, nucleus blabbing and sinusoidal spaces expansion in the tissue of liver mice. fig.(G-J).

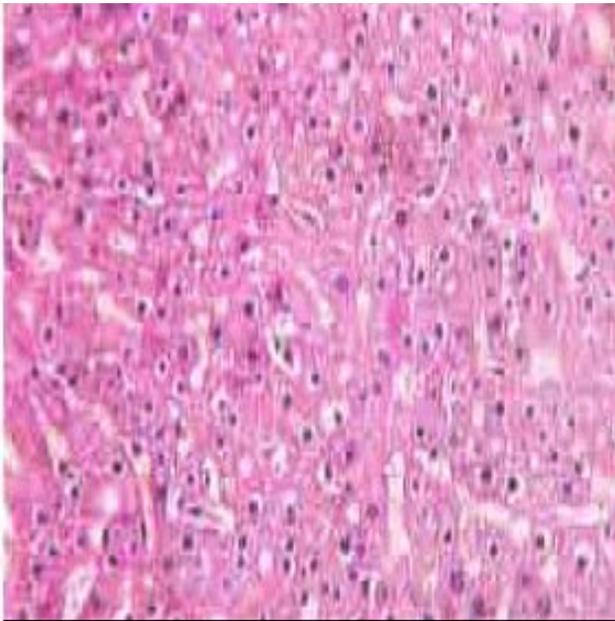


Figure G; Liver of Mice of control group, no necrotic and degenerative changes, normal histology (1600X H and E

FigH; mice liver showing mild necrotic and degenerative changes due to arsenic exposure through water. A, mild necrotic hepatocytes, B; free nuclei, C: mild degree of nuclei blabbing, D: mild cytoplasmic blabbing and hydropic fatty degeneration

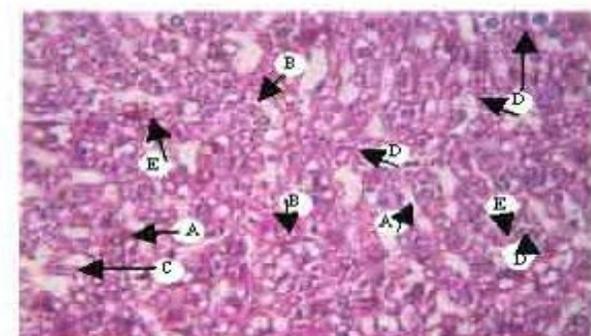
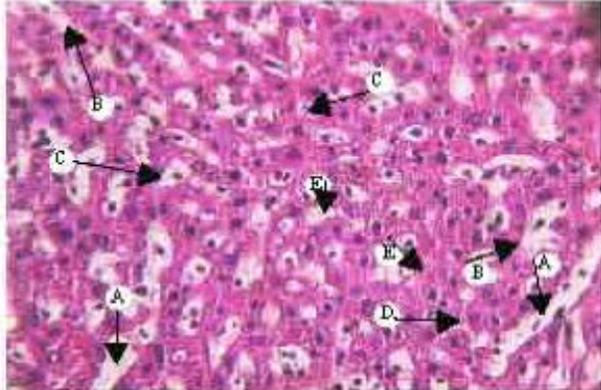
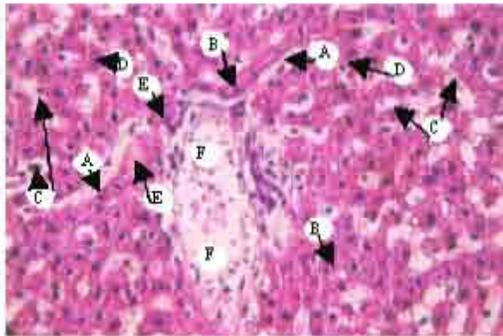


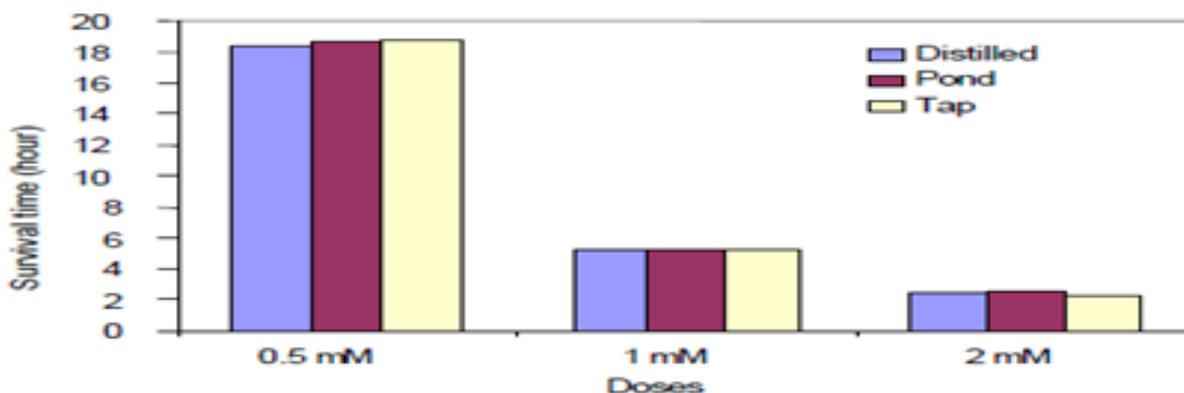
Fig I; Mice liver showing moderate degree of necrotic and degenerative changes due to exposure to 150ppb of arsenic



FigJ; mice liver exposed to 300ppb of arsenic in daily water

nuclei (C), nucleus vacoulation or blabbing (D), severe cytoplasmic vacoulation (blabbing) due to hydropic and fatty degeneration (E), central vein in showing necrosis of endothelium (1600X H and E)

According to Ahmed *et al.*, 2008 different concentrations of NaAsO₂ ranging from 0.5 mM up to 2 mM were used and when the fishes (*Channa straitus*) exposed to high concentration (2 mM) of NaAsO₂, they died within 2 and half hour. However, as the concentrations decreased, the survival period increased gradually. For 1mM and 0.5 mM of NaAsO₂ the survival time was over 5 hours and 18 hours respectively; however, Survival durations of the exposed fishes did not vary according to different water sources. Figure K



FigureK: comparison of survival period of fish after exposure to different concentrations of NaAsO₂ in different water types

III. DISCUSSION

Liver is a target organ and primary site of detoxification and is generally the major site of intense metabolism and is therefore prone to various disorders as a consequence of exposure to the toxins of extrinsic as well as intrinsic forms. Liver plays important role in metabolism to maintain energy level and structural stability of the body (16). It is also the site of biotransformation by which a toxic compound has been transformed in less harmful form to reduce toxicity; however, it is exposed to damage and produce hepatotoxicity (17). According to (10) though the liver plays an important role in metabolic processes and detoxification of many antibiotics, acute exposures to arsenic may lead to accumulate in the liver and cause pathological alteration. Moreover, cell injury of certain organs like liver leads to the release of tissue specific enzymes into the bloodstream. Significant increase in transaminases (AST and ALT) activity in fish exposed to arsenic could be due to possible leakage of enzymes across damaged plasma membranes and/or the increased synthesis of enzymes by the liver. Arsenic administration increased serum AST and ALT activities of fishes reflecting a situation of tissue damage.

Enzymes are biochemical macromolecules that control metabolic processes of organisms, thus a slight variation in enzyme activities would affect the organism (11). Common environmental contaminates such as metals pose serious risks to biochemical parameters and enzyme activities of fish and it is proved that fish subjected to metals have a reduced protein, glycogen level and enhanced enzymes (ALT,AST and ALP) activity (18).

The aspartate aminotransferase (AST) and alanine aminotransferase (ALT) are two important enzymes working as an important link between carbohydrates and protein metabolism in addition AST catalyses the inter conversion of aspartic acid and α -ketoglutaric acid to oxaloacetic acid and glutamic acid. While ALT catalyses the inter conversion of alanine and α -ketoglutaric acid to pyruvic acid and glutamic acid (16)(13). ALT and AST participate in transamination reactions and found predominantly in liver, cardiac cells and striated muscle tissue. Cellular damage releases the ALT and AST into the blood stream and the levels of these enzymes have the potential to indicate hepatotoxicity (16)(6). Serum ALT and AST are usually elevated in serious hepatic damage and the extent of organ damage is

dependent on the type of toxicant, its mechanism of action and duration of exposure (6). This elevation in Serum ALT and AST has been well supported by(13) that is, examined sample of subjects in India demonstrated that arsenic exposure induced liver enlargement with concomitant elevation in levels of alkaline phosphatase, aspartate aminotransferase and alanine aminotransferase. Other investigations conducted in Bangladesh have shown that significant difference in alkaline phosphatase activity in a sample exposed to arsenic compared to that of a non-exposed sample and another study of arsenic-endemic and non endemic population in India have shown that arsenic elevated the activity of blood proteins/enzymes assessed by liver function tests (6).

A number of studies in humans exposed to inorganic arsenic by the oral route have noted signs of hepatic injury. Clinical examination often revealed that the liver is swollen and tender and analysis of blood shows elevated levels of hepatic enzymes; these effects are most often observed after repeated exposure to doses of 0.01–0.1 mg As/kg/day though doses as low as 0.006 mg As/kg/day have been reported to be effective with chronic exposure along with this histological examination of the liver tissue chronically exposed to similar doses has revealed a consistent finding of portal tract fibrosis, leading in some cases to portal hypertension (3). Several studies are reporting arsenic-induced liver fibrosis, hepatocellular damage, inflammation, focal necrosis in addition to hepatocellular carcinoma (9). Histopathological changes in different animals by heavy metals have been reported by several investigators thus the liver under sodium arsenate showed necrosis, appearance of vacuoles, nuclear degenerative changes in experimental animals (13). Chronic arsenic poisoning can cause serious health effects including cancers, melanosis (hyperpigmentation or hypopigmentation), hyperkeratosis (harden skin), restrictive lung disease, peripheral vascular, gangrene, diabetes mellitus, hypertension and ischaemic heart disease (14). Hepatic cancer and other hepatic disorders are considered to be the major causes of arsenic-related mortality (6).

According to epidemiologic studies and clinical observations, arsenic is associated with increased risk for certain types of human cancers, including epidermoid carcinomas of skin, lung cancers, and possibly liver cancers (19). General adverse health effects associated with human exposure to arsenic include cardiovascular diseases, developmental abnormalities,

neurologic and behavioral disorders, diabetes, hearing loss, fibrosis of the liver and lung and hematological (4).

In this review liver enzymes such as ALT, AST and GDH have shown marked increment and on the other hand some antioxidants like GSH, MDA, SOD, SH and ALP, ACP have shown decrement under the exposure of different concentration of arsenic; for example the toxic effects of arsenic trioxide (As_2O_3) on the survival and biochemical profiles i.e. serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) activity of *Labeo rohita* have shown increment upon exposure to lethal concentrations of arsenic (28.30 mg/L), i.e. serum alanine aminotransferase (ALT) level of *L. rohita* exposed to arsenic trioxide showed an activity of 641.18 IU/L at 24 h and 798.11 IU/L at 96 h exposure (Figure 1), this result was significant when compared with the control that have shown 487.25 IU/L at 24 h and 399.7 IU/L at 96 h, respectively. Similar trends were also observed in serum AST of fish exposed to arsenic that showed an activity of 1532.77 IU/L at 24 h and 1622.39 IU/L at 96 h exposure. And the control has shown 1085.72 IU/L at 24 h and 861.58 IU/L at 96 h, respectively. (Figure 2). These results indicated that arsenic toxicity increase the level of liver enzymes of fish (*Labeo rohita*) up on the exposure of the same dose of arsenic as the time of exposure increase.

It is also reported that the plasma levels of aspartate aminotransferase (AST), alanine aminotransferase (ALT) were significantly increased in fishes (*Clarias gariepinus*) exposed to 1/10 lethal concentration (LC50) and 1/20 lethal concentration (LC50) of arsenic, i.e. in serum AST and ALT of fish exposed to arsenic that have shown an activity of $(65.513 \pm 4.152, 58.724 \pm 5.136)$ and $(62.692 \pm 4.212, 51.937 \pm 5.214)$ respectively, and have shown significant variation when compared with the control that showed the activities of serum (AST and ALT), i.e. 48.432 ± 5.121 and 40.592 ± 6.927 respectively. Table 3, in those reports the activities (AST & ALT) in the treatment groups were increased significantly over the recorded value of control group, that is the increment was also significantly higher in fishes (*Clarias gariepinus*) exposed to 1/10 LC50 of arsenic (which is the higher dose), whereas it was non-significantly differed for fishes exposed to 1/20 LC50 of arsenic. This report indicated that as the dose of arsenic increases it leads to varied degree of liver cell damage that is shape deformation, vacuolization, enlargement, necrosis and degeneration of hepatocyte. Figure 3.

It has been reported that Serum alanine amino transferase (ALT) activity has shown an increase of 6.03% in single dose, 13.61% in double dose and 27.75% in multiple doses. Similarly the levels of aspartate amino transferase (AST) has shown an elevation of 9.04% in single, 16.32% in double and 38.08% in multiple dose when compared to control groups. Similarly the glutamate dehydrogenase (GDH) activity has shown an increased level of 9.61% in single, 23.72% in double and 34.62% in multiple doses when compared to control groups, upon the administration of 4.2 mg/kg sodium arsenate in albino mice (13). Table 1.

Severe pathological changes were observed in the tissue mice liver exposed to all dose of sodium arsenate like necrosis of hepatocytes, nuclear degeneration and vacuoles (fig. A-E). Relatively more pronounced changes like cytoplasmic degeneration, emptied portal vein and binucleated has been

absorbed in mice liver tissue exposed to multiple dose of sodium arsenate when compared to that of single and double doses (Fig. D & E). This indicated that as the concentration of arsenic increases cytoarchitectural changes in liver tissue increases and this has been supported by (6)(7) and (14).

The liver tissue of fish has shown significant decrease in all enzymatic activity (i.e. on acid phosphatase (ACP), alkaline phosphatase (ALP), glutamate pyruvate transaminase, (GPT) and glutamate-oxaloacetate transaminase (GOT)) up on exposure to the 144 $\mu\text{g/L}$ and 96 $\mu\text{g/L}$ arsenic concentration. But the decrement was not significant at the lower concentration (96 $\mu\text{g/L}$) (11). Table 2.

According to (11) the variation in enzyme activities in heavy metal treated fish is due to increased permeability of the cell as well as the direct effect of the arsenic on the tissue; therefore, significant deletion of enzymes in fishes exposed to arsenic observed can be attributed to increased arsenic levels in the tissue. Furthermore, accumulation of arsenic in liver could be the possible reason for variation of enzyme activities. The decreased activities of GOT, GPT, ACP and ALP indicated disturbance in the structure and integrity of cell organelles, like endoplasmic reticulum and membrane transport system. As arsenic toxicity induces oxidative stress, the antioxidant enzymes (especially the glutathione – dependent enzymes), react to defend against arsenic toxicity. It has shown that activities of glutathione-S-transferases, glutathione peroxidase, glutathione reductase and catalase decreased in the liver as a result of arsenic; this can be correlated with the decrease in GOT and GPT activities in the fishes exposed to arsenic.

It has been reported that Varied degrees of pathological changes (mild to severe) in the liver tissue of mice were observed in 30, 150 and 300 ppb exposed groups and results necrosis of hepatocytes, central vein, cytoplasmic, nucleus blabbing and sinusoidal spaces expansion due to shrinkage and necrosis of hepatocytes. (fig. G-J). The cells of the liver were showing mild hydropic and fatty degeneration of cells (Fig. H). The degenerated cells were showing mild cytoplasmic vacuolation, cytoplasmic blabbing and necrosis of the hepatocytes. Necrosed patches were in small number; hemorrhages were not frequent throughout the organ cytoplasm and have granular appearance due to the hydropic and fatty degeneration, showing vacuoles.

The group exposed to water containing 150 and 300 ppb of arsenic revealed moderate and severe type of histopathological changes respectively. Degenerated cells has shown severe cytoplasmic vacuolation, cytoplasmic blabbing and necrosis of the hepatocytes and the sinusoidal spaces were expanded due to shrinkage and necrosis of hepatic cells. (Fig I-J). (19)(6) and (7). According to Ahmed *et al.*, in 2008 different concentrations of $NaAsO_2$ ranging from 0.5 mM up to 2 mM were used and when the fishes (*Channa straitus*) exposed to high concentration (2 mM) of Na_2AsO_2 ; they died within 2 and half hour. However, as the concentration decreased, the survival period increased gradually. For 1mM and 0.5 mM of $NaAsO_2$ the survival time was over 5 hours and 18 hours respectively; however, Survival durations of the exposed fishes did not vary according to different water sources. (Fig. K).

During exposure a large amount of slime was produced by the fishes due to toxic effects of arsenic and compared with the control fishes and the exposed fishes were found to suffer from

suffocation and respiratory problems that might cause them to die. Fishes liver exposed to high concentrations of arsenic caused cell death in large numbers, whereas low concentrations induced a lower rate of cell death. The control liver cells were almost all live (98% viable cells). However, viable cell number decreased drastically (38%) after exposure of the fishes to 2 mM of NaAsO₂ and Viable cell number gradually increased with decreasing concentrations of NaAsO₂ (for 1 mM= 68% viable cells and for 0.5 mM=92% viable cell) (14). Arsenic is a potential sulfhydryl-reactive compound that aggregates with a number of cell surface proteins. Aggregation of cellular proteins, increases production of reactive oxygen species and activation of protein tyrosine kinases by arsenic might be together or individually involved in the process of cell death (14). This report indicated that as the dose of arsenic increases with increasing time of exposure the severity of hepatic cell damage increased.

Generally, in all the reports of study, the variation in the activates of the enzymes may be related to the toxicant concentration, duration of the exposure, species differences and the methodology used e.g, variation in the physico-chemical characteristics of the water used for holding and experiments such as pH, temperature, alkalinity, sulphates and chlorides.

IV. CONCLUSION

Generally, this review is to reveal the extent of toxicity of arsenic on liver tissue of mice and fishes and different concentration of arsenic has shown toxic effect in activities of different enzymes of liver tissue of fishes and mice. I.e. in most cases the result showed increment in most activities of enzymes and decrement in some other types of enzymes and showed different pathological changes in the tissue of experimental animals. This variation in the activities of the enzymes may be related to the toxicant concentration, duration of the exposure, species differences and the methodology used. Measuring the serum levels of the different enzymes in fishes and mice in response to arsenic toxicity are potential biomarkers of hepatotoxicity.

REFERENCES

- [1] Nuran E., Gurer HO, and Burns NA. Toxic metals and oxidative stress part I: mechanisms involved in metal induced oxidative damage, Current topic in medical chemistry 2001; 1; 529-539.
- [2] Saha. JC., Dikshit AK., Bandyopadhyay M. and Saha KC. A review of arsenic poisoning and its effects on human health. International journal of epidemiology 1988; 17;589-594.
- [3] Agency for Toxic Substances and Disease Registry. Toxicological profile for arsenic 2000; 243-270.
- [4] Sohini S. and Rana S.V.S. Amelioration of arsenic toxicity by L-Ascorbic acid in laboratory rat. Journal of environmental biology 2007; 28(2): 377-384.

- [5] Celino F T., Yamaguchi S., Miura C. and Miura T. Arsenic inhibits in vitro spermatogenesis and induces germ cell apoptosis in japanese eel (anguilla japonica). Society for reproduction and fertility 2009; 138; 279-28.
- [6] Islam K., Haque A., Karim R., Fajol A., Hossain E., Salam KA., Ali N., Saud ZA., Rahman M., Rahman M., Karim R., Sultana P., Hossain M., Akhand AA., Mandal A., Miyataka H., Himeno S. and Hossain K. Dose-response relationship between arsenic exposure and the serum enzymes for liver function tests in the individuals exposed to arsenic. Environmental health 2001; 10 (64):1-11.
- [7] Ferzand R., Gadahi JA., Saleha and Qurban Ali Q. Histological and hematological disturbance caused by arsenic toxicity in mice model. Pakistan journal of biological sciences 2008; 11 (11): 1405-1413.
- [8] Gieter MD., Leermakers M., Ryssen RV., Novena J., Goeyens L. and Baeyens W. Total and toxic arsenic levels in North Sea fish. Archives of environmental contamination and toxicology 2002; 43: 406-417.
- [9] Allah NH., Hameid A. A protective effect of calcium carbonate against arsenic toxicity of the Nile catfish, *Clarias gariepinus*. Turkish journal of fisheries and aquatic sciences 2009; 9:191-200.
- [10] Vutukuru SS., Prabhath NA., Raghavender M. and Yerramilli A. Effect of arsenic and chromium on the serum amino-transferases activities in Indian major carp, *Labeo rohita*. International journal of environmental research of public health 2007; 4(3): 224-227.
- [11] Humtsoe N., Davoodi R., Kulkarni BG. and Chavan B. Effect of arsenic on the enzymes of the rohu carp, *Labeo rohita*. The raffles bulletin of zoology 2007; 14; 17-19.
- [12] palaniappan P. and vijayasundaram V. First study of arsenic induced biochemical changes on the liver tissues of fresh water fingerlings *Labeo rohita*. Romanian journal of biology and physics 2008; 18(2):135-144.
- [13] Devaraju T., Sujatha K., Rao SM. and Rao KJ. Impact of sodium arsenate on selected enzymes and histopathological studies in albino mice. International journal of pharmacy and biological sciences 2010; 1(3): 344-354.
- [14] Ahmed K., Akhand AA., Hasan M., Islam M. and Hasan A. Toxicity of arsenic (sodium arsenite) to fresh water spotted snakehead *Channa punctatus* (Bloch) on cellular death and DNA content. American- Eurasian journal of agriculture. & environmental sciences 2008;4 (1): 18-22.
- [15] Liu KT., Wang GQ., Ma LY., Jang P., Xiao BY., Urumqi CH. and Jiang X. Adverse effect of combined arsenic and fluoride on liver and kidney in rats. fluoride 1999; 32(4):243-247.
- [16] Paliwal A., Gurjar RK. and Sharma HN. Analysis of liver enzymes in albino rat under stress of λ -cyhalothrin and nuvan toxicity. Biology and medicine 2009; 1 (2); 70-73.
- [17] Hodgson. Text book of modern toxicology, 3rd ed. John Wiley & sons, inc., Hoboken, New Jersey, Canada; 2004.
- [18] Fatma, AS., Mohamed N. and Gad NS; Environmental pollution induced biochemical changes in tissues of *Tilapia zillii*, *Solea vulgaris* and *Mugilcapito* from Lake Qarun. Global Veterinaria, 2008; 2(6):327-336.

AUTHORS

First Author – Kidanemariam Gaim, MSc, Biomedical Science
Department Mekelle University, Ethiopia

Second Author – Girmay Gebru, PhD Biomedical science
Department Addis Ababa University, Ethiopia

Third Author – Sunday Abba, MSc, Biomedical science
Department, Mekelle University, Ethiopia

Correspondence Author – Sunday Abba, email;
suneabba007@gmail.com/ suneabba007@yahoo.co.uk/
+251932054115

Effect of Chemical Fertilizers on Dielectric Properties of Soils at Microwave Frequency

VidyaD.Ahire*, D.V.Ahire*[^] and P.R.Chaudhari*

*Microwave Research Laboratory, Department of Physics, Z. B. Patil College, Dhule - 424002, India

Email: dvahire@rediffmail.com (Correspondence Author)[^]

Abstract-Fertilized black soil samples are prepared by mixing desired amounts of fertilizers in the black soils having 10% gravimetric moisture content. Two black soil samples were collected from two different locations of Maharashtra State (India). Three different chemical fertilizers viz., Urea, Di-Ammonium Phosphate and Potash are used. Measurements of complex dielectric constants of these soil samples have been carried out at C-band microwave frequency 4.6 GHz by using waveguide cell method. The average values of dielectric constant and dielectric loss of two unfertilized moist black soil (10% MC) samples at frequency 4.6 GHz are 7.6 and 0.43 for sample A and 9.6 and 0.38 for Sample B, respectively. The variation in values of dielectric constant and dielectric loss of these moist black soil samples mixed with different fertilizer contents are then measured at fixed frequency 4.6 GHz. The concentrations of fertilizers in the soil samples are varied over a range from 0 to 0.12 %. The dielectric constant and dielectric loss are found to increase with increase in fertilizer contents. Out of these three fertilizers, relative increase in dielectric properties is found highest for Urea and lowest for Potash. Other electric parameters such as a. c. conductivity (σ) and relaxation time (τ) also show increase in their values with respect to increase in the fertilizer concentrations. The physical and chemical properties of the black soil samples are also provided. Possible applications and extensions of this study are also outlined.

Index Terms- Complex dielectric constant, soil, chemical fertilizers, ac conductivity, relaxation time, microwave frequency.

I. INTRODUCTION

Soil depletion occurs when the components which contribute to fertility are removed and the conditions which support soil fertility are not maintained. This leads to poor crop yields. In agriculture, depletion can be due to excessively intense cultivation and improper utilization of soil. Topsoil (depth ranging 0-20 cm) depletion occurs when the nutrient-rich organic topsoil, which takes hundreds to thousands of years to build up under natural conditions, is eroded. Therefore, in order to sustain soil fertility, nutrients removed from the soil by crops must be restored by the application of manures and fertilizers. Thus, fertilizers supply plant food and help to increase the yield of different crops through the improvement of soil fertility. Fertile soil produces abundant crops under suitable environmental conditions. However, addition of different fertilizers may change the physical, chemical and dielectric properties of the soil.

Several researchers have reported the findings of their studies on the variation of dielectric characteristics of fertilized soils at microwave frequencies. Wang J. R. and Schmugge T. J. [1] showed that the dielectric constant is directly proportional to pore- space of soil. Results of Yadav V. et al. [2] have further showed that, due to more pore space the grains of the crops get the sufficient space for growth, so fertility of soil is also increased. Heiniger R. W. et al. [3] outlined the necessity of soil test to determine status of available nutrients and to develop fertilizer recommendations to achieve optimum crop production. Experimental results of Yadav V. et al. [2] at X-band frequency show increase in the values of dielectric constant, dielectric loss, a.c. conductivity and relaxation time with increase in the concentration of fertilizers in the soil. Yadav, et al. [4] have further experimentally studied the variation in the dielectric constant of mixture of water content with fertilizers. Navarkhele V. V. et al. [5] and Shaikh A. A. and Navarkhele V. V. [6] have also studied the dielectric properties of black soil with inorganic and organic matters at X-band microwave frequencies. Chaudhari H. C. and Shinde V. J. [7] have determined a. c. electrical conductivity (σ), and relaxation time (τ) of soil from experimentally measured values of complex dielectric constants of red and black soils. Gadani D. H. et al. [8] have studied the dielectric properties of wet and fertilized soils at radio frequencies using precision LCR meter. Their results show increase in the values of dielectric constant and dielectric loss with increase in the concentration of fertilizers in the soil.

Research of this kind enriches our knowledge of soil science and thus is very much beneficial to the farmers. Therefore, the present study reports the experimental results on the variations of dielectric constant, dielectric loss, a. c. conductivity and relaxation time of black soils for different fertilizer contents at C-band microwave frequency (4.6 GHz). Most of the earlier investigators have studied dielectric properties of fertilized soils by adding fertilizers in dry soils at X-band microwave frequencies. However, as per agricultural norms, the fertilizer addition is more effective in moist soils than in dry soils for efficient nutrients transportation to the crops/plants. Therefore, in the present work, fertilized soil samples are prepared by mixing desired amount of fertilizers in the soil having 10% gravimetric moisture content.

II. MATERIALS AND METHODS

A. Preparation of soil samples

Two soil samples (A and B) having black colour and of wide marginal textural difference were collected from two places, viz., from Amalner (Dist. Jalgaon) and Nandurbar (Dist. Nandurbar). Both of these districts are located in the northern region of Maharashtra State (India). Soils were first sieved by gyrator sieve shaker to remove the coarser particles. The sieved out finest particles are then oven dried to a temperature around 110°C for several hours in order to completely remove any trace of moisture. Such dry sample is then called as oven dry or dry base sample when compared with wet samples. Soil samples of 10% gravimetric moisture contents are prepared by adding an exact amount of distilled water to the known mass of the oven dry soil. The fertilized soil samples are then prepared by mixing different concentrations of fertilizers in the black soil having 10% MC. These mixtures are kept in a closed container and allowed for few hours to facilitate internal drainage, homogenous mixing and proper settlement. These fertilized soil samples are then inserted into the solid dielectric cell for measuring their dielectric properties. Extreme care was taken to expose them to the atmospheric air as little as possible. Three different chemical fertilizers used in these experiments are Urea, Di-Ammonium Phosphate (D.A.P.) and Potash. The concentrations of fertilizers are varied over a range from 0 to 0.12 %. These concentration levels nearly match with the norms specified by the agricultural department.

B. Soil physical and chemical properties

The physico-chemical soil analysis reports of the two black soil samples (A and B) used in this study were obtained from Soil Testing Laboratory, Government Agricultural College, Pune. Table 1 presents the physical and chemical properties of these black soil samples. It indicates that both the soil samples used are alkaline in nature and their electrical conductivity values lie within the normal range.

Table 1: Physical and chemical properties of unfertilized black soils

(a) Physical properties

(b) Chemical properties

Soil Properties		Soil Sample Name	
		Sample-A	Sample-B
Texture	Sand	20	61
	Silt	31	20
	Clay	49	19
Textural Class		Clay	Sandy loam
Bulk Density		1.27	1.55
Particle Density		2.5	2.61
Soil Colour		Black	Black
WP		0.29	0.12
W _t		0.31	0.224
Porosity		49.2	40.6

Soil Properties	Soil Sample Name	
	Sample-A	Sample-B
pH	7.2	8.25
EC (dS/m)	0.33	0.10
OC %	0.65	0.23
CaCO ₃ %	4	6.4
N (Kg/ha.)	238	163
P (Kg/ha.)	16.9	6.2
K (Kg/ha.)	610	412

The Wilting Point (WP) and Transition Moisture (W_t) of the soils are calculated by using the Wang J. R. and Schumge T. J. Model [1] as follows:

$$WP = 0.06774 - 0.00064 \times \text{Sand (\%)} + 0.00478 \times \text{Clay (\%)} \quad \dots (1)$$

$$W_t = 0.49 \times WP + 0.165 \quad \dots (2)$$

C. Method of measurement of dielectric properties

The waveguide cell method is used to determine the dielectric properties of the fertilized black soil samples. An automated C-band microwave set-up in the TE₁₀ mode with Gunn source operating at frequency 4.6 GHz, PC-based slotted line control and data acquisition system is used for this purpose. Experiments were performed at room temperatures ranged between 30°-35° C. The solid dielectric cell with soil sample is connected to the opposite end of the source. The signal generated from the microwave source is allowed to incident on the soil sample. The sample reflects part of the incident signal from its front surface. The reflected wave combined with incident wave to give a standing wave pattern. These standing wave patterns are then used in determining the values of shift in minima resulted due to before and after inserting the sample. The dielectric constant ϵ' and dielectric loss ϵ'' of the fertilized soils are then determined from the following relations:

$$\epsilon' = \frac{g_{\epsilon} + (\lambda_{gs} / 2a)^2}{1 + (\lambda_{gs} / 2a)^2} \quad \dots \quad (3)$$

$$\epsilon'' = -\frac{\beta_{\epsilon}}{1 + (\lambda_{gs} / 2a)^2} \quad \dots \quad (4)$$

From the measurement of dielectric constant and dielectric loss, other electric parameters like a. c. conductivity and relaxation time can be obtained by using equations (5) and (6)

$$\sigma = \omega \epsilon_0 \epsilon'' \quad \dots \quad (5)$$

$$\tau = \epsilon'' / \omega \epsilon' \quad \dots \quad (6)$$

- Where, a = inner width of rectangular waveguide.
 λ_{gs} = wavelength in the air-filled guide.
 g_{ϵ} = real part of the admittance
 β_{ϵ} = imaginary part of the admittance
 ω = $2\pi f$ = angular frequency, $f = 4.6$ GHz
 ϵ_0 = permittivity of free space.

III. RESULTS AND DISCUSSION

The initial average values of dielectric constant and dielectric loss of two unfertilized oven-dry black soil samples at frequency 4.6 GHz are 3.85 and 0.16 for sample A and 3.1 and 0.1 for sample B. Further, the average values of dielectric constant and dielectric loss of two unfertilized moist black soil (10% MC) samples at frequency 4.6 GHz are 7.6 and 0.43 for sample A and 9.6 and 0.38 for Sample B. Our experimental results on the variations of dielectric constant, dielectric loss, a. c. conductivity, and relaxation time for these two black soil samples having constant value of MC (10%), with the concentration of different fertilizers are summarized in Figs. 1 to 4.

Fig. 1(a) shows the variations of dielectric constant of soil sample A for different fertilizer concentrations (%) at 4.6 GHz. The dielectric constant is found to increase with increase in fertilizer concentrations from 0 to 0.12 %. This variation is approximately linear and the trend is almost similar for all the three fertilizers used in these measurements, except the little differences in the relative magnitudes of dielectric constant. Out of these three fertilizers, relative increase in dielectric constant is found highest for Urea and lowest for Potash. The departures in the curves for three fertilizers are more for higher fertilizer concentrations. For fertilized moist soil samples prepared by using Urea, the values of ϵ' ranges from 7.6 to 8.7 for its concentration changed from 0% to 0.12%. Whereas, when the fertilized moist soil samples are prepared by using D.A.P. and Potash, the corresponding values of ϵ' ranged from 7.6 to 8.54 and 7.6 to 8.35 respectively, for their concentrations changed over the same range. Fig. 1(b) shows the variations of dielectric constant of soil sample B for fertilizer concentrations (%) at 4.6 GHz over the same range. The results show almost similar trends except the differences in their relative magnitudes. For this case, when fertilized moist soil samples are prepared by using Urea, the values of ϵ' ranges from 9.6 to 10.9 for its concentration changed from 0% to 0.12%. Whereas, when the fertilized moist soil samples are prepared by using D.A.P. and Potash, the corresponding values of ϵ' ranged from 9.6 to 10.63 and 9.6 to 10.4 respectively, for their concentrations changed over the same range. However, the reaction of urea in presence of soil is acidic but less acid producing than D.A.P. Therefore, excessive use of these two fertilizers may cause acidity in soils. On the other hand, Potash fertilizer is neutral in reaction and hence can be found more effective in acidic soils.

Fig. 2 (a) and (b) show the variations of dielectric loss with different fertilizer concentrations (%) for soil samples A and B respectively. In both cases, the dielectric loss is found to increase with increase in fertilizer concentrations over a range from 0 to 0.12 %. The trend of variations is almost similar as that for dielectric constant discussed in Fig. 1, except the differences in their magnitudes. Thus, value of dielectric constant and dielectric loss of these soils increases with fertilizer contents. However, it is further observed that the relative increase of dielectric loss is comparatively more than dielectric constant over the range of fertilizer concentration studied.

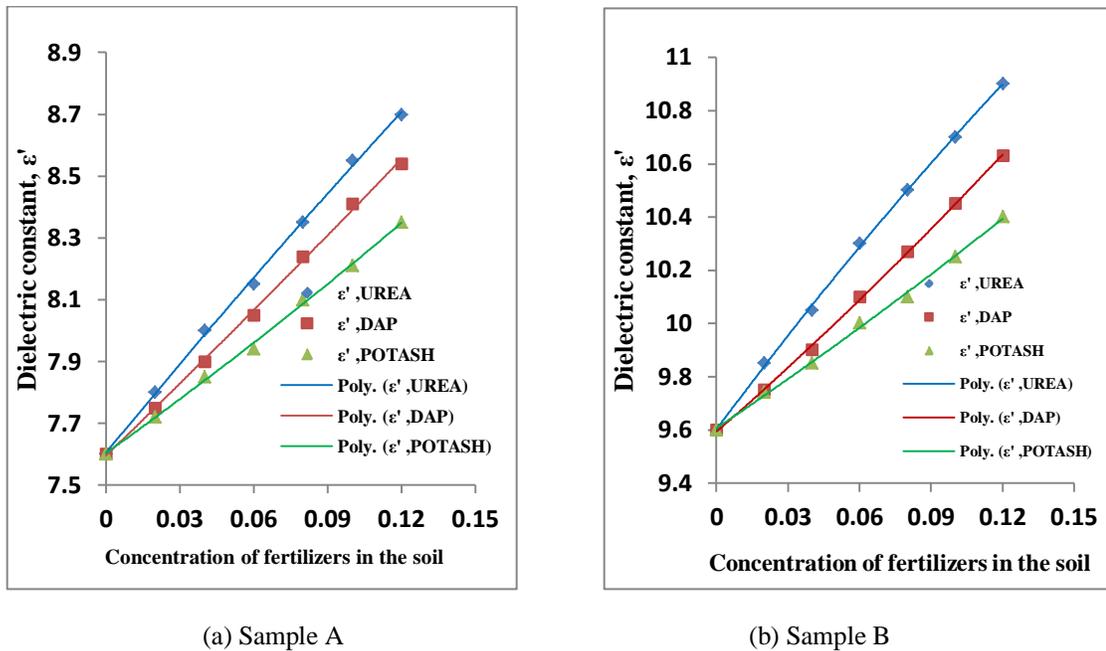


Figure 1. Variation of dielectric constant of soil (10% MC) with different fertilizers contents at frequency 4.6 GHz.

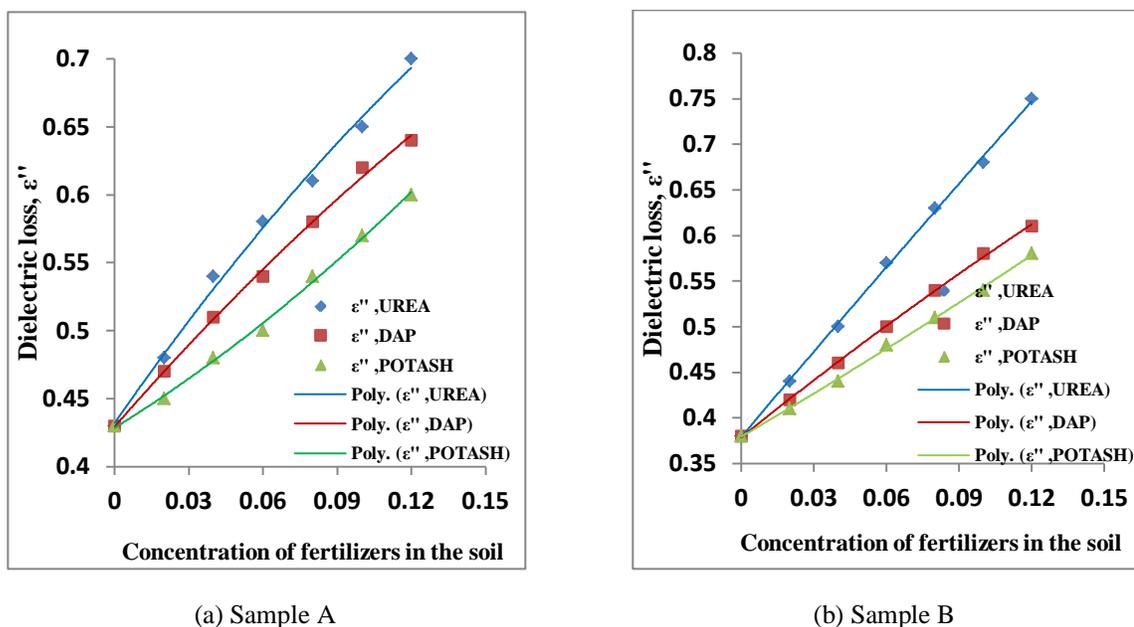


Figure 2. Variation of dielectric loss of soil (10% MC) with different fertilizers contents at frequency 4.6 GHz.

Our results presented in Figs. 1 and 2 show fairly good agreements with the results of the several investigators [2,4,5,6,7,8,9,10]. However, the soil moisture, type and amount of fertilizer added, operating frequency, etc. are different. We know that dielectric constant has strong dependence on the moisture content present in the soil. It increases with the increase in the amount of moisture content in the soil. Addition of fertilizers in the soil having constant MC (10%) also show approximately linear increase in the ϵ'

with increase in the concentration of fertilizers. This may be due to the fact that the added fertilizers matter forms a chemical composition of low concentration along with the chemicals present in the soil. According to the theory of electrolyte, in the limit of low concentration the dependence of ϵ' is approximately linear. By adding fertilizer the water holding capacity of soil improves. The dielectric loss of soil is also found to increase with increase in the concentration of fertilizers. The reason may be that ϵ'' is a parameter which describes the motion of electric charge leading to the conduction phenomenon [5,6]. Certain dielectrics display conduction which arises from the actual charge transport rather than due to the displacement current. Such conduction is described by volume conductivity which adds an additional term to the dielectric loss ϵ'' . Due to this additional term the dielectric loss increases with increase in fertilizer content in the soil.

Fig. 3 (a) and (b) show the variations of a. c. conductivity of soils for different fertilizer concentrations (%) for sample A and B respectively. In both cases, the a. c. conductivity is found to increase with increase in fertilizer concentrations over a range from 0 to 0.12 %. This variation is approximately linear and the trend is almost similar for all the three different fertilizers used in these measurements. Out of these three fertilizers, relative increase in σ is found highest for Urea and lowest for Potash. This result is expected, because the motion of charges in the dielectric (soil) gives rise to the conduction current and hence polarizes the dielectric. This dielectric polarization is thus found to increase with the concentration of fertilizers. This shows that the conduction is by displacement current and therefore contributes to the dielectric attenuation/loss. Further, the measured values of σ for the black soil samples used in this study are of higher range and it may be due to their high clay percentages. This shows the presence of large number of weakly bound ions in these clayey or soft materials. Such dielectric studies of materials, thus is a powerful tool in assessing the structure and behaviour of molecular materials [11,12].

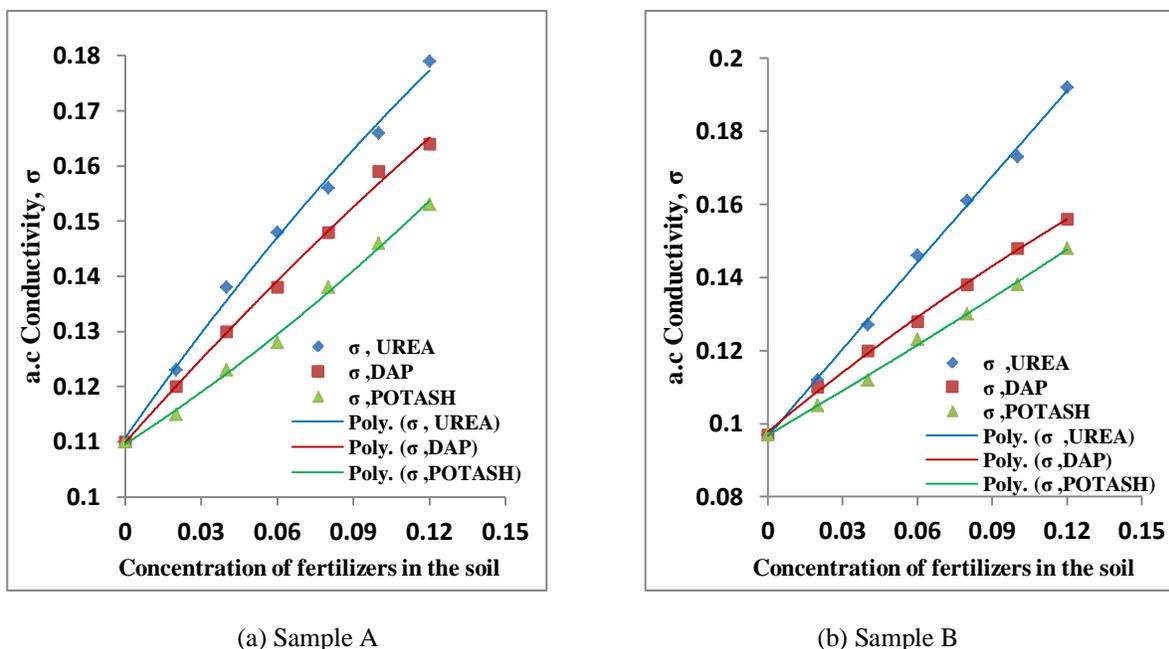


Figure 3: Variation of a. c. electrical conductivity of soil (10% MC) with different fertilizers contents at frequency 4.6 GHz.

Fig. 4 (a) and (b) show the variations of relaxation time of soils for different fertilizer concentrations (%) for sample A and B respectively. In both cases, the relaxation time is found to increase with increase in fertilizer concentrations over a range from 0 to 0.12 %. This suggests that the mobility of the molecules (dipoles) of soils decreases with addition of fertilizers in it. However, this variation is nonlinear and the trend is almost similar for all the three different fertilizers used in these measurements. Out of these three fertilizers, relative increase is found highest for Urea and lowest for Potash. This result is expected, as τ is proportional to the dissipation factor (ϵ''/ϵ'). Molecular relaxation time is assumed to be due to the inner friction of the medium that hinders the rotation of the polar molecules. Therefore τ is also a function of MC. The increase in the relaxation time with MC is due increase in hindrance to the polarization process in soils. Our results further indicate that hindrance to polarization process in the soils having fixed MC is directly proportional to the amount of fertilizer content. Our results discussed here found good agreement with the experimental results of earlier investigators [2,4,5,6,7,8,9,13,14].

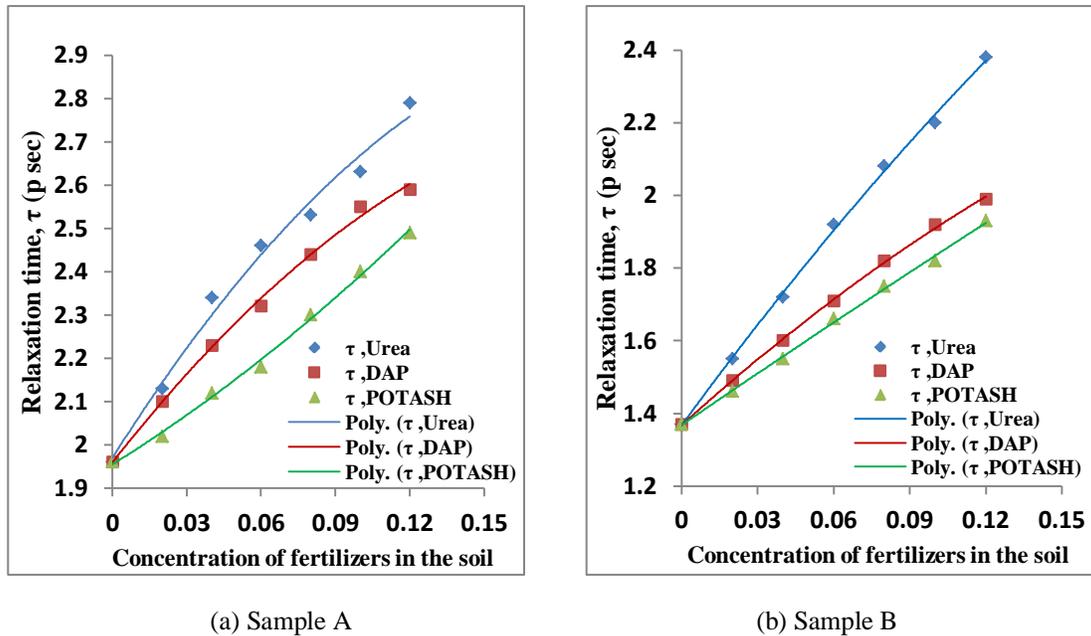


Figure 4: Variation of relaxation time of soil (10% MC) with different fertilizers contents at frequency 4.6 GHz.

Our results given in Figs. 1 to 4 have little higher values of dielectric parameters for the black soil sample B compared to sample A. This can be explained from their physical and chemical properties listed in Table-1. This shows that dielectric constant of oven-dry (0% MC) soil samples is positively correlated with electrical conductivity, macronutrients (N,P,K) and organic carbon, while it is negatively correlated with pH and CaCO_3 . Results shown in Figs. 1 to 4 further indicate that the values of dielectric constant, dielectric loss, a. c. conductivity, and relaxation time of the moist black soil samples increases with increase in fertilizer concentrations. In all cases, the relative increase in these parameters is found highest for Urea and lowest for Potash. Further, this effect is more pronounced at higher concentrations of these three fertilizers used. Thus, addition of fertilizers increases the pore-space and hence the fertility of the soil [1]. The different types of fertilizers have different chemical compositions. Therefore, the above experimental results clearly show that urea increases relatively more pore-space in the given soil as compared to D.A.P. and potash. Such studies on dielectric properties of fertilized soils are not only useful in understanding the structural behavior of soil but also for its efficient use in crop production. Further, these results may find uses in deciding the correct types and amounts of fertilizers for the supply of the specific nutrients. Such studies may be extended over different frequencies, for various soil types and by taking large number of samples.

Our results also give comparatively higher values of dielectric parameters for the unfertilized as well as fertilized moist (10% MC) black soil sample B compared to sample A having same MC value. This shows the dependence of dielectric parameters and also effectiveness of fertilizers studied on the texture/structure and chemical properties of soils.

IV. CONCLUSIONS

This study indicates that the values of dielectric constant, dielectric loss, a. c. conductivity, and relaxation time of the moist black soil samples increases with increase in fertilizer concentrations. The relative increase in these parameters is found highest for Urea and lowest for Potash. Further, this effect is more pronounced at higher concentrations of these three fertilizers used. This shows that the fertilizer increase generates more pore-space into the soil. Due to more pore-space, the dielectric constant and hence fertility of soil is also increased. Our results also give little higher values of dielectric parameters for the black soil sample B compared to sample A. This can be explained from the differences in their physical and chemical properties. The results of this study may find uses not only in understanding the soil microstructure but also in deciding the correct types and amounts of fertilizers for the supply of the specific nutrients.

ACKNOWLEDGEMENT

The authors are very much grateful to the Principal, Z. B. Patil College, Dhule, for providing research facilities and also thankful to Prof. OPN Calla, ICRS, Jodhpur, for his kind suggestions during the course of this research work.

REFERENCES

- [1] Wang J. R. and Schmugge T. J., *IEEE Trans. Geosci. Remote sens.*, vol. 18, 1980, pp288- 295.
- [2] Yadav, V., Anil Kumar, A. Sharan, S. Sinha, A.K. Yadav, M. Gupta, V.K. and Jangid, R. A., *Journal of Agricultural Science*, vol.42, 2009, pp 42-49.
- [3] Heiniger, R. W. McBride, R. G. and. Clay, D. E., *Agronomy Journal*, vol. 95, 2003, pp508-519.
- [4] Yadav, V. Kumar, A. Sharan, S. and Sinha, A. K., *International Journal of the Physical Sciences*, vol. 5(16), 2010, pp2466- 2470.
- [5] Navarkhele, V. V. Shaikh, A. A. and Ramshetti, R. S., (2009), *Indian J. of Radio and Space Physics*, vol. 38, 2009, pp112-115.
- [6] Shaikh A. A. and Nawarkhele V. V., *Frontiers of Microwaves and Optoelectronics, Proceedings of International Conference on Microwaves and Optoelectronics, Anamaya Publishers, New Delhi, India, 2008, p879.*
- [7] Chaudhari, H. C. and Shinde, V. J., *International Journal of physical Science*, vol. 3(3), 2008, pp75-78.
- [8] Gadani D. H., Vyas A. D. And Rana V. A., *Indian J. of Radio and Space Physics*, vol. 52, 2014, pp399-410.
- [9] Chaudhari H.C., Deshmukh S.B., Agrawal P.R. and Shinde V.J., *Proceedings of International Conference on Microwaves and Optoelectronics (ICMO-2007), Aurangabad (Maharashtra), 2007, pp891- 896.*
- [10] Botcher C. J. F., *Elsevier Pub. Com. Ams. Houston, London*, p415.
- [11] Roberts, S. and Hippel A. Von, *Journal of Applied Physics*, vol. 17, 1946, pp610-616.
- [12] Hippel A. Von, *Dielectric Materials and Applications, John Wiley and Sons, Inc., 1961, p314.*
- [13] Sengwa R. J. and Soni A., *Indian Journal of Radio and Space Physics*, vol. 37, 2008, p57.
- [14] Sengwa R. J., and Soni A., *Geophysics*, vol. 71/5, 2006, pG269.

AUTHORS

First Author –Dr. Mrs. Vidya D. Ahire, M.Sc. Ph.D. (Physics), Associate Professor, Microwave Research Laboratory, Department of Physics, JET's Z. B. Patil College, Dhule

Second Author--Dr. D.V.Ahire, M.Sc. ,Ph.D.(Physics), Associate Professor and Ex. Head, Microwave Research Laboratory, Department of Physics, JET's Z. B. Patil College, Dhule

Third Author – Dr. P. R. Chaudhari, M.Sc. ,Ph.D.(Physics), Associate Professor, Microwave Research Laboratory, Department of Physics, JET's Z. B. Patil College, Dhule

Correspondence Author – Dr. D.V.Ahire, M.Sc. ,Ph.D.(Physics),
Associate Professor and Ex. Head, Microwave Research Laboratory,
Department of Physics, JET's Z. B. Patil College, Dhule 424002
Email: dvahire@rediffmail.com
Mobile Number: +91 9423979468

Patient's Perception Regarding Nursing Care at Inpatient Department of Hospitals in Bhaktapur District

Sumitra Twayana^{*}, Ram Hari Adhikari^{**}

^{*} Health Care Management, National Open College

Abstract- Health is a fundamental human right and essence of productive life. Hospital is the part of social system which provides health care services to the sick people. The services at hospital is mostly depends on the nursing care because they spend more time with patients care for their better health. The study objective is to assess the patients' perception regarding nursing care in Inpatient Department off Hospitals in Bhaktapur District. A descriptive cross- sectional study was used to study patients' perception on nursing care at hospitals in Bhaktapur District. A total of 140 respondents were selected for the study by questionnaire including Likert Scale was used to collect the data. Descriptive and inferential statistic (Chi – Square Test) was used to identify the association between the variables by using SPSS version 21. Results: The results of the study showed that the mean age of respondents was 43.21 with SD (+) or (-) 18.9. The total mean score of patients' perception of nursing care on Likert Scale was 97.32 out of 115, with a standard deviation of (+) or (-) 13.45 and 63.6 % of respondents (n=89) had positive perception whereas 36.4% of respondents(n=51) had negative perception on overall aspect of nursing care. There were 33.6% of respondents (n=47) who had negative perception in the dimension of Physical Environment and Facilities. Conclusion and Recommendation: The finding showed that there was no association between demographic characteristics with the levels of perception with the nursing care. Recommendation: In order to provide quality health care services and facilities to the patients the patients' perception towards nursing services should be monitor routinely at the hospital

Keywords—Inpatient Department, Nursing Care, Patient Perception

I. INTRODUCTION

Perception can be defined as the way of thinking about or understand someone or something. Patient's Perception is generally considered as the patient's view of services received and the results of the treatment.

Patients are the main user for every hospital. The primary function of the hospital is supporting the patients' total medical care during a period of an illness in the hospital. The patient care in hospital is mostly depending on the quality of nursing care. As quality nursing care is the heartbeat of the hospital. It helps to run the hospital smoothly and also help patients on reducing the average length of stay at the hospital. Patients' Perception with quality of nursing care in hospital is considered to be important element for the quality improvement of the hospital. It may affect

patients' health outcomes and their behaviour or psychological well- being after hospital stay.

Nurses' attitudes towards patients have great influence on patients' perceptions of nursing care. They have a lot of expectations from nurses about their care. Hence, they require a lot of information about their conditions, procedures, treatment options and expectations on nursing care during hospitalization. This study therefore, intended to assess some thematic areas that have not been addressed such as perceptions and experiences regarding nursing care

II. OBJECTIVES

General Objective

The general objective of this study is to assess the patients' perception regarding nursing care in a selected hospital wards.

Specific Objectives

The specific objectives of this study are as follows:

- To identify the patients' perception towards of nursing care in the wards.
- To assess the patient's perception on the nursing Attitude and behaviour.
- To assess the patient's perception on physical facilities and physical environment.
- To identify the role of patients' length of stay to determine patients' perception on nursing care.

III. LITERATURE REVIEW

A study on Patients' Perception towards Quality Nursing Care done by Gupta BS et.al, 2014) was a descriptive quantitative and qualitative research design was adopted and study areas were Bir-hospital and Tribhuvan University Teaching Hospital (TUTH). Non probability purposive sampling technique with semi structured interview questionnaire including Likert Scale was used to collect the data. Descriptive and inferential statistics were used for analysis. Overall perception of respondents about nursing care (nurses' behavior, safety and security and admission procedure) is positive as 182 (91%) perceived positively, whereas 18 (9%) perceived negatively (not positive). A study concluded that most of the respondents showed positive attitude towards quality nursing care in both hospitals.

Another study done in Pakistan, (Khan, et.al, 2007) showed that out of 122 patients 45% of patients were satisfied with the care provided, while 55% were partially dissatisfied. Among six dimensions of care, 94% liked nursing practice of keeping privacy of patients, 84% had negative experiences as they observed nurses were not attentive to their needs, particularly at night. It was concluded that the patients' expectations were not sufficiently met.

A study on Patients' Perception of quality nursing care in a Chinese hospital, study 440 patients (purposive sample) in 18 inpatient nursing units in a China hospital were selected. A questionnaire on the perception of quality nursing care scale was distributed to patients to find out the level of quality care perceived by them. The overall mean score and each category mean score of the quality of nursing care as perceived by patients were at a high level. Patients perceived the highest mean score in the category of progress of the nursing process, while they perceived the lowest in preconditions for care. Also, it was observed that quality nursing care presented a challenge for nursing administrators to develop strategies for improving nursing care in those categories where patients had lower quality nursing care than others, such as psychological support or the nurse's sense of humor. (Shi H. Zhao at.el, 2011)

It can be summarized that patients' perceptions of nursing care determines the quality of nursing care. Patient's satisfaction affected by patient's characteristics, nurses' behaviour and professional knowledge and skills. Therefore, the patient may become more satisfied with nursing care if nurses meet patient's needs, expectations and provide adequate information on patient's condition and treatment

IV. METHODOLOGY

A cross sectional descriptive study design was used to measure patients' perception of nursing care in inpatient department of selected hospital in Bhaktapur District. Total of 140 patients selected for the study by using purposive sampling technique based on inclusion criteria (patients aged above 18 years or older and have spend at least 24 hours or more).

A self - interview questionnaire with a verbal consent of respondents was used for data collection.

The collected data was analyzed using statistical package for social sciences (SPSS). Results were presented in descriptive statistics and inferential statistic (Chi- Square test).

V. RESULT AND DISCUSSION

The results showed that the mean age of samples were 43.21 with SD (+) or (-) 18.9. Half of the respondents were males (52.1%) while females respondents were (47.9%). Out of 140 respondents the youngest patient was 18 years and oldest was 86 years old. The mean score was 43.21 and standard deviation (SD) was (+) or (-) 18.09. The average length of stay was 5.9 days and most of them (71.4%) were stayed in the ward for 2-5 days. A very few patients (12.1%) and (16.4%) were stayed for 6-9 days and 10 days more.

Table 1: Mean, standard deviation, frequency and percentage of overall patients' perception of nursing care

Perception	Frequency	Percent
Positive (Perception ≥ mean)	89	63.6
Negative (Perception < mean)	51	34.4
Mean = 97.32	SD=13.45	Max=115
		Min=51

Table 2: Frequency and Percentage distribution of patients' perception of nursing care in various Aspects

Aspects	Positive		Negative	
	No	%	No	%
Interpersonal Care at ward	91	65.0%	49	35.0%
Attitude and Behavior	98	70.0%	42	30.0%
Physical Environment & Facilities	93	66.4%	47	33.6%

Table 3: Association between patients' length of stay and their perception of nursing care

Length of Stay (day)	Total	Perception Level		Chi Square- Value
		Positive No %	Negative No %	
2-5 Days	100	64 64%	36 36%	χ^2 0.09
6-9 Days	17	11 67.70%	6 35.30%	DF 2
>10 Days	23	14 60.90%	9 39.10%	P 0.956

Table 1 shows that the Table 4.1.12 shows that the total mean score of patients' perception of nursing care was 97.32 with standard deviation of (+) or (-) 13.45. This indicates that the patients' perception of nursing care is positive (63.6%).

Table 2 reveals the three aspects of nursing care such as interpersonal care at ward, Nurses Attitude & Behavior, and Physical environment & facilities. Above 60% patients had positive perception regarding these three aspects. There were 1/3 patients had negative perception in the aspects of interpersonal care, attitude & behaviour and physical facilities.

Table 3 showed that the association between patients' length of stay and perception of nursing care and there were not statistically significant.

Conclusion and Recommendation

This study on patients' perception of overall aspects of nursing care was positive. A Patients' perceived on support service facilities i.e , safe drinking water, bed linen and visitors sitting chairs was negative, so support service should be properly in order to increase positive patients' perception on nursing care. This study finding helps the hospital administrator/policy maker to plan and develop strategies focused on quality nursing care. Therefore, a hospital should organize nursing education programme and skill training workshops for the nurses in order to improve patients' perception of quality of nursing care.

REFERENCES

Ariba, A.J., Thanni, L.O. and Adebayo, EO. (2007) ' Patients' perception of quality of emergency care in a Nigerian teaching hospital': The influence of patient-provider interactions, Department of General Medical Practice, Olabisi Onabanjo University, Sagamu, Ogun State, Nigeria. *Postgrad Med J* ; pp296-301

Gupta, B.S. and Thulung B.K. (2014) 'Patient's Perception towards quality Nursing Care', Nepal Health Research Council, Aug (12(27); 83-7

Khan, M.H., Hassan R., Anwar S., Babar T.S., & Babar K.S. (2007) ' Patient Satisfaction with Nursing care', *Rawal Medical Journal*: Vol.32, Issue 1 pp 27-29.

Ndambuki, J. (2013) 'The level of patients' satisfaction and perception on quality of nursing services in the Renal unit', Kenyatta National Hospital Nairobi, Kenya, The University of Nairobi, Kenya . *Journal of Nursing*; Vol 3, pp 186-194

Shi H. Zhao and Thitinut Akkadechaunt. Patients' perceptions of quality nursing care in a Chinese Hospital, *International Journal of Nursing and Midwifery*. Vol.3 (9), pp. 145-149, September 2011. Available on www.academicjournals.org/ijnm

AUTHORS

First Author – Sumitra Twayana , Master of Health Care Management , sumitratwayana@gmail.com , +977-9841887028

Second Author – Ram Hari Adhikari, Master in Public Health, ramhariadhikari17@yahoo.com

Effect of Corporate Wellbeing Practices On Employees' Performance among Commercial Banks in Kenya

Ben Bett Tuwai^{*}, Cyrus Kamau^{**}, Samson Kuria^{**}

^{*} Department of Human Resource Management, Kenyatta University of Agriculture and Technology

^{**} Department of Purchasing and Supplies, Southhub Enterprises

^{**} Samson Kuria, Department of Project Management, Safaricom Foundation

Abstract- The main aim of this project was to explore the effect of corporate wellbeing programmes on employees' performance among commercial banks in Kenya since corporate well being programmes used by commercial banks on employees have been an area of interest to researchers lately. However, the main concentration has been performance programmes such as motivation and training and development only. Little research has been done on corporate wellbeing programmes as a way of improving performance among commercial banks in Kenya. Organizations in Kenya are slowly adopting corporate wellbeing programmes though. In this research, the target population is 43 commercial banks in Kenya where Heads of HR were targeted. For inclusion purpose, Census sampling method was used to collect data as sampling method omitted important population. Research instrument were both structured and unstructured questionnaires as major data collection instruments and the researcher mainly used qualitative analysis techniques and descriptive methods to analyze data collected from the organization of study. Data was presented in tables and charts. The study found out that financial, intellectual, environmental, social and physical wellness programs improved employee's performance. Financial wellness programs to affect employee's performance. Intellectual wellness programs were indicated to enable employees improve their knowledge and skills which should make the more effective and efficient in the workplace. Most respondents indicated environmental wellness programs to affect employee's performance. Social wellness programs allows employees to interact with people from different cultures where they share ideas which may be beneficial to their workplace. Physical wellness programs are important to employees as they keep employees healthy, a healthy employee is an asset to the organization. The study recommended that banks should come up with long term investment advice to employees which will be beneficial in their retirement age. Intellectual wellness programs should enable employees be more creative by coming up with ways of solving problems encountered by the organization. Employees should be allowed to suggest the best environment which would make them work better. Social wellness programs should aim at improving the relationship between employees and how they should work together as a team. Physical wellness programs should aim at improving overall health of employee where a healthy employee should perform better in the organization.

Definition of Terms Used

Corporate Wellness- is any workplace health promotion activity or organizational policy designed to support healthy behavior in the workplace and to improve health outcomes (Perry, 2010).

Environmental Wellness- Environmental wellness is the ability to recognize employees own responsibility for the quality of the air, the water and the land that surrounds us (Anderson et al, 2010).

Financial Wellness- According to Aggarwal & Bhargava, (2009), it is the establishing and maintaining healthy spending and saving habits among employees.

Intellectual Wellness - Intellectual wellness is the ability to open minds to new ideas and experiences that can be applied to personal decisions, group interaction and community betterment (Ongore, 2011).

Physical Wellness- Physical Wellness is the ability to maintain a healthy quality of life that allows employees to get through daily activities without undue fatigue or physical stress (Ajzen & Icek, 2011).

I. INTRODUCTION

A 1.1 Background

According to Anderson, Quinn, Glanz, Ramirez, Kahwati, Johnson, Buchanan, Archer, Chattopadhyay, Kalra, & Katz (2010), the concept of well-being has been a historical development one. Well-being is as a result from the fulfillment of important needs of the individuals and realization of goals and plans set for one's life. Anderson et al., (2010) further argues that goal-orientated activity and commitment to tasks creates well-being. Compared to this, the history of well-being at work is short. The quality and productivity concept of working life has only recently been used, and includes, for example, learning and social activities (Aggarwal & Bhargava, 2009). The objective here is to produce a more sustainable and a holistic development process for workplaces which is more systematic and includes the idea of "doing together (Ajzen & Icek, 2011).

Taylor & Don (2010) sees a wellness program as a way of promoting maintenance of good health rather than correction of poor health. Depending on structure and culture of the an organization, wellness programs may include fitness programs, recreational opportunities, social activities, and programs that enhances intellectual and spiritual development. Workplace wellness programs significantly impacts on company bottom line, more particularly for the small businesses where the

employee well-being is seen to greatly affect overall productivity (Naydeck & Pearson, 2009).

Himmelstein, Thorne, Warren, & Woolhandler (2009) argues that by developing new and integrated concept of well-being at workplace from a viewpoint of the workplace can be particularly important, since many of the concepts have been recommended by experts from different fields, for example occupational health services, occupational safety, and organizational consultancy. Since they have been brought from outside of the companies, they have mostly remained fragmented and isolated actions which have no real link to daily activities of various workplaces (Marcolin & Abraham, 2012).

1.2 Summary of the Major Findings

On gender, majority of respondents who participated in the study were male. On age, most of the respondents who participated in the study were middle aged people. On education level, majority of the total responses had Masters Degree level of education. On working experience, majority of respondents had worked for a long period. Most respondents felt that bank wellness programs were weak and did not help employees realize their full potential. Most respondents indicated that bank wellness programs helps employees' improve productivity. Majority of respondents indicated that bank wellness programs lead to job satisfaction among employees. Majority of respondents felt that bank wellness programmes did not improve employee's effectiveness at work. Most respondents indicated that financial, intellectual, environmental, social and physical wellness programs improved employee's performance. Banks which has wellness programs has healthy, dedicated and motivated employees.

1.2.1 Effect of Employees Financial Wellness Programmes on Employees' Performance

Most respondents indicated financial wellness programs to affect employee's performance when the organization were able to put strategies in place to enable employees plan their financial future. The findings collaborates with Dowling et al., (2010) who found that employee financial wellness is the missing piece to maximizing the effectiveness of existing wellness programs and fully containing health care costs. Financial wellness programs like financial planning, investment planning and budget advice leads to job satisfaction, low turnover and productivity. Medical/healthcare planning programs were found to affect employee performance among employees. The findings collaborates with the study by Marcolin & Abraham (2012) who argued that financial challenges can lead to increased levels of stress and anxiety that are often carried with them to the workplace therefore medical/ healthcare planning is important in addressing the challenges. General budgeting advice to employees was found by most respondents to have little effect on employee performance which disagrees with Marcolin & Abraham (2012) who argued that financial challenges can lead to increased levels of stress and anxiety that are often carried with them to the workplace. Credit restoration/repair resources programmes was found to have little effect on employee performance. The findings disagrees with Garman et al., (2010) who argued that financial incentive motivates actions which otherwise might not occur without the monetary benefit this shows that credit

restoration/repair resources programmes were not effectively utilized. Most respondents felt that employee's privacy, security and fraud protection education did not affected employee performance since privacy, security and fraud protection education programs did not aim at protecting employees from losing money and how they could invest their money. the findings disagrees with Marcolin, & Abraham (2012) who argued that financial education forms the foundation of a financial wellness program which shows that financial education was not well conducted among commercial banks in Kenya. Most banks were indicated to offer investment advice in housing and stock markets. Budgeting advice was indicated by employees to enable employees plan their finances which enabled them meet their financial goals. Most respondents were of the opinion that banks should come up with long term investment advice to employees which will be beneficial in their retirement age. The findings have shown strong relationship between financial wellness and employee's performance. The findings will enable commercial banks take necessary steps to improve financial wellness of employees. Financial wellness programs that have little effect on employee's performance will be abolished and replaced with more effective ones.

1.2.2 Effect of Employees Intellectual Wellness Programmes on Employees' Performance

Majority of respondents indicated intellectual wellness programs to affect employee's performance when employees gained knowledge and skills which will help the solve work related challenges. The study findings agrees with with Perry (2010) who argued that intellectual wellbeing programs enables acquisition of knowledge, skills, and competencies as a result of the teaching of vocational or practical skills and knowledge that relate to specific useful competencies which shows that intellectual wellness programs in commercial bank improve the way employees handle various challenges at workplace. Intellectual wellness programs like training opportunities, mental fitness, quiz bowl and trivial assignments leads to job satisfaction, low turnover and productivity among employees. Most respondents indicated employees' openness to new ideas to affect their performance when employees gained from exchange of ideas which would help employees overcome the workplace challenges. The study finding which agreed with Himmelstein et al., (2009) who argued that openness to new ideas improved employees intellectual ability which improved their performance Most respondents felt that searching for ways to use creativity affected employees performance when employees engaged in activities that would make the stimulate their minds and enable them to solve complex problems. The study findings agrees with Berry (2010) who argued that quiz bowls or trivia contests help to test employees' intellectual ability which shows that creativity programs employed by commercial banks were effective. Most respondents indicated that employees' search for lifelong learning opportunities and stimulating mental activities improved their performance when employees gained from knowledge and skills to improve their job related tasks. The study findings agrees with agrees with Osayameh (2011) who argued that the desire to learn new concepts, improve skills and seek challenges in pursuit of lifelong learning contributes to our intellectual wellness which helps improve performance which shows that lifelong learning

opportunities programs by commercial banks improved employees performance. Most respondents felt that employees' search for personal growth through learning of new skills helps improve their performance as they develop new ways of approaching work related issues. The study findings agrees with Osayameh (2011) who argued that provision of knowledge, skills and tools are necessary to make positive health and lifestyle choices; as well as the skills needed in order to change and support positive behavior which shows that personal growth programs employed by commercial banks improved employees performance. Most respondents felt that employee's openness to new ideas allowed exchange of ideas which are work related which enabled employees overcome challenges in their work place. Intellectual wellness programs were indicated by most respondents to enable employees improve their knowledge and skills which should make the more effective and efficient in the workplace. Most respondents were of the opinion that the banks should come up with programs aimed at identifying and developing employees with special talents. From the findings, there was a strong relationship between intellectual wellness and employee's performance. The findings will enable commercial banks take necessary steps to improve intellectual wellness of employees. Intellectual wellness programs that have little effect on employees performance will be abolished and replaced with more effective ones.

1.2.3 Effect of Employees Environmental Wellness Programmes on Employees' Performance

Environmental wellness programs was found to affect employees' performance when working environment determined how employees performed, the study collaborates with Lee (2009) who argued that elements of the organizational environment include leadership style, management practices, the way in which work is organized; employee autonomy and control, and social support which shows that commercial banks embraced environmental wellness programs. Environmental wellness programs like ergonomics education, fire safety, ventilated and lighted building assignments leads to job satisfaction, low turnover and productivity among employees. Most respondents indicated that fire safety initiatives to have little effected on employee's performance when the management lacked clear strategies on what should happen incase the fire occurs. The findings disagrees with Robert (2012) who argued that implementing strategies that encourage employees to engage in healthy behaviors will allow the organization to improve the overall health and productivity of the workforce which shows that fire safety initiatives had little effect on employees performance. Most respondents felt that ventilated and lighted building affected employee's performance when the air and light penetration in the building determined the health of employees which collaborates with Robert (2012) this program implements a combination of changes to the physical and social environment that aim to influence individual health behavior which shows that commercial banks had implemented ventilated and lighten building programs. Well ventilated and lighted building impacts positively on employee's performance as there are little cases of sickness. Most respondents indicated that ergonomic education to affect employees' performance when the education equipped employees with work related skills.

Fire safety programs made employees feel safe in their places of work which motivated them to work harder. Most respondents were of the opinion that employees should be allowed to suggest the best environment which would make them work better which collaborates with Levi, Segal & Kohn (2011) who argued that organizational policies that support employees wanting to make healthier lifestyle choices are important to creating effective worksite wellness programs which shows that commercial banks have been implementing ergonomic education. The findings have shown environmental wellness to play a major role in employee's performance. The findings will be of great significance to commercial banks since they will improve their working environments which will enable employees perform better. Environmental wellness programs that have little effect on employee's performance will be abolished and replaced with more effective ones.

1.2.3 Effect of Employees Social Wellness Programmes on Employees' Performance

Majority of respondents indicated that social wellness programs to affect employee's performance when employees gained social skills which are necessary in improving employee's teamwork performance which collaborates with Robert (2012) that the ability to establish and maintain positive co-workers contributes to our social wellness which influences teamwork performance which shows that commercial banks social wellness programs improves employees performance. Social wellness programs like leaves/vacations, team bulding, flexible work arrangements leads to job satisfaction, low turnover and productivity among employees. Most respondents indicated that flexible work arrangements to affect employees' performance when employees are given leaves and vacations to enable them relax their mind to enable them reflect on their goals which collaborates with Onger (2013) that flexible work may allow more freedom to organize their work to fit in with other parts of their life which shows that commercial banks in Kenya embraced flexible work arrangement programs. Most respondents indicated that regular team building programs affected employee's performance when employees engage in teamwork activities outside the place of work, team building activities improve teamwork performance in the organization which collaborates with Ongore (2011) that the overall goals of team building are to increase the teams understanding of team dynamics and improve how the team works together which shows that commercial banks in Kenya embraced team building programs. Most respondents felt that giving employees' time offs to be with their families and friends affected their performance when employees took time off from stressful work environment which collaborates with Osayameh (2011) that a leave of absence (LOA) should be a period of time that one must be away from his/her primary job which helps improve performance which shows that most commercial banks had time offs for their employees. Most respondents felt that exploration of diversity through interaction with people of other cultures, backgrounds and beliefs led to exchange of ideas in different work environments which improved employee's performance. Corporate social responsibilities is a way of giving back to the community which improves the organization image to its customers which disagrees with Rath & Harter (2010) that

diversity programs allows employees to explore issues related to problem solving, creativity, and learning as well as spending more time pursuing personal interests which shows that commercial banks did not embrace diversity programs which negatively affected employee's performance. Social wellness programs allows employees to interact with people from different cultures where they share ideas which may be beneficial to their workplace. From the findings, there is a strong relationship between social wellness and employee's performance. The findings will enable commercial banks take necessary steps to improve social wellness of employees. Social wellness programs that have little effect on employee's performance will be abolished and replaced with more effective ones.

1.2.4 Effect of Employees Physical Wellness Programmes on Employees' Performance

Most respondents felt that physical wellness programs to affect employees' performance when employees engaged in physical activities which are aimed at improving their health which shows that physical wellness programs greatly affected employees performance which collaborates with O'Donnell (2009) who indicated that physical wellness programs improves employees health which impacts on their performance at the workplace which shows that commercial banks embraced employees physical wellness programs which improved their performance. Physical wellness programs like exercise facilities, fitness programs and fitness fairs leads to job satisfaction, low turnover and productivity among employees which shows that physical health programs did not affect employees performance which disagrees with O'Donnell (2009) who indicated that physical health brings the benefits of looking good and feeling terrific most often lead to the psychological benefits of enhanced self-esteem, self-control, determination and a sense of direction which shows that physical health programs were not embraced in commercial banks. Most respondents felt that employees' knowledge of important health numbers like their cholesterol level, weight, blood pressure, blood sugar amongst others did not affect their performance since such medical tests were not regularly conducted. Most respondents felt that drug awareness and counseling for employees did not affected their performance when employees kept on aging on activities that negatively affected their performance which shows that drug awareness and counseling programs had little effect on employee performance which disagrees with Paddock & Catherine (2009) who argued that short-term changes in individual behavior and even improvements in productivity can occur as a result of awareness and counseling programs which shows that drug awareness and counseling programs were not embraced by commercial banks in Kenya. Most respondents felt that established physical exercise

routine did not affect employees' performance as most respondents were too busy to engage in physical exercise activities physical exercise programs affected employees performance which shows physical wellness programs greatly affect employees performance which collaborates with Miller & Harlem (2009) who indicated that worksite's fitness programmes are important for organization as it can lower employees' absenteeism and job turnover which shows that commercial banks in Kenya embraces physical exercise programs. The findings have shown strong relationship between physical wellness and employee's performance. The findings will enable commercial banks take necessary steps to improve physical wellness of employees. Physical wellness programs that have little effect on employees performance will be abolished.

II. CONCLUSIONS

Financial wellness programs affected employee's performance when the organization were able to put strategies in place to enable employees plan their financial future. A healthy employee is an asset to the organization, medical/ healthcare planning programs help employee's access medical services which reduces cases of illness. Intellectual wellness programs affected employee's performance when employees gained knowledge and skills which enables them overcome challenges that comes with their day today job. Environmental wellness programs affected employee's performance when they are satisfied with their working conditions. Employees need to feel safe in their places of work. Employees feel confident and motivated when they are working in safe environment.

Social wellness programs are aimed at ensuring the employees work together as a team in the organization therefore improving performance. Flexible work arrangements relieves the employee's stress that comes with the job. Regular team building programs encourages employees to work as a team to achieve the organization objectives. Giving employees' time offs to be with their families and friends enables employees to socialize which relieves them pressure from the job which may be helpful in improving performance in the organization.

Physical wellness programs are important to employees as they keep employees healthy, a healthy employee is an asset to the organization. Drug awareness and counseling for employees protects the employees from engaging in drugs or activities which negatively affects employee's performance. Stress negatively affects employee's performance. Counseling on stress management enables employees to focus on their job. Fitness programs in the organization protects employees from diseases.

APPENDICES

APPENDIX I: INTRODUCTION LETTER

Dear Respondent,

I am a student at the Jomo Kenyatta university of Agriculture and Technology pursuing masters of Science in Human Resources Management. I am working on a project, which is a requirement in the partial fulfillment for the degree of Masters of Science in Human Resources Management.

Below is a questionnaire: I would like you to either tick or fill in where appropriate. All data and information gathered is purely for academics purpose and will be treated with confidentiality.

I thank you in advance for your cooperation in this regard and may God bless you.

Yours Faithfully,

BEN BETT

APPENDIX II: QUESTIONNAIRE

This questionnaire seeks information on the effect of corporate wellbeing programmes on employees' performance among commercial banks in Kenya. All the information you give will be treated with confidentiality and used for academic purposes only and nothing else what so ever. Please take a few minutes to complete this questionnaire.

SECTION A: DEMOGRAPHIC INFORMATION

Name (Optional)

Please tick appropriately

Tick as appropriate

1. Gender

Male

Female

2. Indicate age bracket:

18-30 yrs

31-40 yrs

- 41-50 yrs
- Above 51 yrs

3. **Highest Education Level**

- Degree level
- Masters level
- PHD level

Any other please specify.....

4. **Working experience**

- Below 1 year
- 1-5years
- 6-10 years
- 11-20 years
- 21 and above

SECTION B: EMPLOYEE PERFORMANCE

5. Does your banks wellness programmes affect employees' performance?

- Yes (3)
- No (2)
- Don't Know (1)

6. Is it true that employees realize their full potential through bank wellness programs help?

- Yes (3)
- No (2)
- Don't Know (1)

7. If yes (6) above, how has wellness programs helped you realize full potential?

.....
.....

8. Bank wellness programs improve employees' productivity

- Yes (3)
- No (2)
- Don't Know (1)

9. If No (8) above, how can banks wellness programs improve employees' productivity?

.....
.....

10. Bank wellness programs lead to job satisfaction

- Yes (3)
- No (2)
- Don't Know (1)

11. Bank wellness programmes improve employees effectiveness at work

- Yes (3)
- No (2)
- Don't Know (1)

12. From your own opinion, what wellness programmes improve employee performance in your bank? (explain)

.....
.....
.....

13. From your own experience, how has bank wellness programmes improved productivity?

.....
.....
.....

SECTION C: FINANCIAL WELLNESS

14. Financial wellness program affect employees' performance

- Yes (3)
- No (2)
- Don't Know (1)

15. Medical/ healthcare planning programs affect employee performance

- Yes (3)
- No (2)
- Don't Know (1)

16. If Yes (15) above, how does medical/ healthcare planning programs affect employee performance?

.....
.....

17. What employees' investment planning programmes do you have? (explain)

.....
.....

18. Do you think general budgeting advice to employees affect employee performance?

- Yes (3)
- No (2)
- Don't Know (1)

19. If yes (18) above, how does general budgeting advice affect employees performance?

.....
.....

20. Does your credit restoration/repair resources programmes affect employee performance?

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

21. Employees privacy, security and fraud protection education affect employee performance.

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

22. If Yes (19) above, how has privacy, security and fraud protection education affected employees performance?

.....
.....

23. From your own opinion, how can financial wellness programmes improve employee's performance?

.....
.....

24. From your own opinion, what are some of financial wellness programs do you think should be introduced?

.....
.....
.....

SECTION C: INTELLECTUAL WELLNESS

25. Does your intellectual wellness programs affect employees' performance?

- a. Yes (3)
- b. No (2)
- c. Don't Know(1)

26. Employees' openness to new ideas affects their performance

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

27. If Yes (25) above, how has employees' openness to new ideas affected their performance?

.....
.....

28. Employees' search for ways to use creativity affects their performance

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

29. If Yes (28) above how has employees' search for ways to use creativity affected their performance?

.....
.....
.....

30. Has employees' search for lifelong learning opportunities and stimulating mental activities improved their performance?

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

31. From your own opinion how has your educational incentives affected employees' performance? (Explain)

.....
.....

32. Employees' search for personal growth through learning of new skills helps improve their performance

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

33. From your own opinion, what intellectual wellness programs improve employee's performance? (Explain)

.....
.....

SECTION D: ENVIRONMENTAL WELLNESS

34. Environmental wellness programs affect employees' performance

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

35. Fire safety initiatives affect employee's performance

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

36. If yes (35) above, how has fire safety initiative affected employees performances?

.....
.....

37. Ventilated and lighted building affect employee's performance

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

38. If Yes (37) above, how has ventilated and lighted building affected employee's performance?

.....
.....

39. Ergonomic education affects employees' performance

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

40. From your own experience, what are environmental employees driven programs that are in the organization? (Explain)

.....
.....

41. From your opinion, how do environmental wellness programs affect employees' performance? (Explain)

.....
.....

SECTION E: SOCIAL WELLNESS

42. Does your social wellness programs affect employees' performance?

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

43. Flexible work arrangements affect employees' performance

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

44. If yes (43) above, how does flexible work arrangements affect employees' performance?

.....
.....

45. Regular team building programs affect employee's performance

- a. Yes(3)
- b. No(2)
- c. Don't Know (1)

46. If yes (45) above, how does regular team building programs affect employee's performance?

.....
.....

47. Giving employees' time offs to be with their families and friends affect their performance

- a. Yes(3)

- b. No (2)
- c. Don't Know (1)

48. How does employees' willingness to actively seek out ways to preserve the beauty and balance of nature and the community affects their performance?

.....
.....
.....

49. Employees' exploration of diversity through interaction with people of other cultures, backgrounds and beliefs affect their performance

- a. Yes(3)
- b. No (2)
- c. Don't Know (1)

50. From your experience, how do social wellness programs affect employees' performance? (Explain)

.....
.....

SECTION E: PHYSICAL WELLNESS

51. Physical wellness programs affect employees' performance

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

52. Employees' knowledge of important health numbers like their cholesterol level, weight, blood pressure, blood sugar amongst others affect their performance

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

53. If yes (52) above, how does employees' knowledge of important health numbers like their cholesterol level, weight, blood pressure, blood sugar amongst others affect employees' performance?

.....
.....
54. Drug awareness and counselling for employees affects their performance

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

55. Established physical exercise routine affects employees' performance?

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

56. If yes (55) above, how does established physical exercise routine affect performance?
.....
.....

57. Employees' annual physical examinations affect their performance

- a. Yes (3)
- b. No (2)
- c. Don't Know (1)

58. From your own opinion, how do your physical wellness programs affect employee's performance?
.....
.....

APPENDIX III: LICENSED COMMERCIAL BANKS IN KENYA AS AT 31ST DECEMBER 2012

1. ABC Bank (Kenya)
2. Bank of Africa
3. Bank of Baroda
4. Bank of India
5. Barclays Bank
6. CFC Stanbic Bank
7. Chase Bank Kenya
8. Citibank
9. Commercial Bank of Africa
10. Consolidated Bank of Kenya
11. Cooperative Bank of Kenya
12. Credit Bank
13. Development Bank of Kenya
14. Diamond Trust Bank
15. Dubai Bank Kenya
16. Ecobank
17. Equatorial Commercial Bank
18. Equity Bank
19. Family Bank
20. Fidelity Commercial Bank Limited
21. GT Bank(formerly Fina Bank)
22. First Community Bank
23. Giro Commercial Bank
24. Guardian Bank
25. Gulf African Bank
26. Habib Bank
27. Habib Bank AG Zurich
28. Housing Finance Bank
29. I&M Bank

30. Imperial Bank Kenya
31. Jamii Bora Bank
32. Kenya Commercial Bank
33. K-Rep Bank
34. Middle East Bank Kenya
35. National Bank of Kenya
36. NIC Bank
37. Oriental Commercial Bank
38. Paramount Universal Bank
39. Prime Bank (Kenya)
40. Standard Chartered Kenya
41. Trans National Bank Kenya
42. United Bank for Africa
43. Victoria Commercial Bank

Source: Central Bank of Kenya (2013)

ACKNOWLEDGMENTS

I would like to acknowledge my project supervisor Dr. Wario Guyo for his inspirational instruction, guidance and his initial impetus to study the Impact of Wellness Programmes on Employee Performance.

REFERENCES

- [1] Aggarwal U., Bhargava S., (2009). Reviewing the relationship between human resource practices and psychological contract and their impact on employee attitude and behaviours. *Journal of European Industrial Training*, 33, 4-31.
- [2] Ajzen, M., Icek ,N (2011) .“Theory of Planned Behavior,” *Psychology and Health* 1st Edition, Longman Publishers. UK, London.
- [3] Anderson, L., Quinn, T., Glanz, K., Ramirez, G., Kahwati, L., Johnson, D., Buchanan L., Archer, W., Chattopadhyay, S., Kalra, G., Katz, D., (2010). The effectiveness of worksite nutrition. *American Journal of Preventive Medicine*, 37(4), 340-357.
- [4] Armstrong M (2013). *Employee Reward*. 2nd Edition, Pal Grave Macmillan Publisher. U.S.A., New York.
- [5] Berry, L., Mirabito, A., Baun, W., (2010). “What’s the Hard Return on Employee Wellness Programs?”. 5th Edition, Macmillan Publishers. U.S.A., New York.
- [6] Central Bank of Kenya, (2012). *Bank Supervision Annual Report*, Government Press. Kenya. Nairobi
- [7] Central Bank of Kenya, (2014). *Bank Supervision Annual Report*, Government Press. Kenya. Nairobi
- [8] Central Bank of Kenya, (2011). *Bank Supervision Annual Report*, Government Press. Kenya. Nairobi
- [9] Central Bank of Kenya, (2009). *Bank Supervision macroeconomic determinants of bank profitability*. Working paper. Government Press. Kenya. Nairobi
- [10] Central Bank of Kenya, (2013). *Bank Supervision macroeconomic determinants of bank profitability*. Working paper. Government Press. Kenya. Nairobi
- [11] Crede, M., Chernyshenko, S., Stark, S., Dalal, S., Bashshur, M., (2007). Job satisfaction as mediator. An assessment of job satisfaction’s position within the nomological network. *Journal of Occupational and Organizational Psychology*, 80 (3), 515–538.
- [12] DeVries N., George M., Thomas, S., (2010). *Innovations in Workplace Wellness: Six New Tools to Enhance Programs and Maximize Employee Health and Productivity*. *Compensation & Benefits Review journal*, 5, 42-46.
- [13] Dowling (2010). *Financial management practices and money attitudes as determinants of financial problems* 1st Edition. Foresight Publisher. U.S.A. Ohio State.
- [14] Edlin M., (2011). “Digital health coaching brings care management to everyday life,” *Managed Healthcare Executive journal*, 1, 24-26.
- [15] Garman, T., Jinhee, K., Kratzer, B., & Joo, S. (2010). Workplace financial education improves personal financial wellness. *Financial Counseling and Planning Journal*, 10, 79-99.
- [16] Himmelstein, D., Thorne, D., Warren, E., & Woolhandler, S. (2009). *Medical Bankruptcy in the United States, 2007: Results of a National Study*. *The American Journal of Medicine*, 2, 41-46.
- [17] Kalani, V., Waweru, N., (2007). *Commercial Banking Crises in Kenya: Causes and Remedies*. 3rd Edition, McGraw-Hill Publisher. U.S.A. New York.

- [17] Kenya National Bureau of Statistics (2012). Employee Performance Report: Government, Press. Kenya. Nairobi.
- [18] KIPPRA, (2013), Employee performance indicators, Banks Performance Report
- [19] Krishnan, S.K., & Singh, M. (2010). "Outcomes of intention to quit of Indian professionals", 4th. Edition., McGraw-Hill. USA. Boston.
- [20] Langille, J., Berry, T., R., Reade, I., Witcher, C., Loitz, C., Rodgers, W., (2011). Strength of Messaging in Changing Attitudes in a Workplace Wellness Program Health Promotion Practices 5th Edition, Macmillan Publishers. U.S.A, New York.
- [21] Lee F., (2009). Labour market regulations and informal employment in China. 1st Edition. Pitman Publication. U.K, London.
- [22] Levi, J., Segal, L., Kohn, D., (2011). "Healthier Americans for a Healthier Economy. 1st Edition. Iowa Publishers. U.S.A. Iowa.
- [23] Linden, A., Butterworth, S., Prochaska, J., (2010). "Motivational interviewing-based health coaching as a chronic care intervention," Journal of Evaluation in Clinical Practice, 16, 167.
- [24] Lusardi, A., & Mithcell, O., (2011). Financial literacy and retirement preparedness: 1st Edition, Foresight Publisher, U.S.A. Ohio State.
- [25] Marcolin, S., Abraham, A. (2012). Financial literacy research. 1st Edition. Pitman Publication. U.K, London.
- [26] Maslow, A.H. (1943). A theory of human motivation. Psychological Review 1st Edition. Pitman Publication. U.K, London.
- [27] Miller, P., & Harlem, C., (2009). Why employers spend money on employee health Interviews with occupational health and safety professionals from British industry. Safety Science . 47(2) 163-169.
- [28] Mugenda, O., & Mugenda, O., (2003). Research Methods: 1st Edition, ACTS Publishers. Kenya. Nairobi.
- [29] Mugenda, O., and Mugenda, O., (1999). Research Methods: 2nd Edition, ACTS Publishers. Kenya. Nairobi.
- [30] Nazarro, A., Strazzabosco, J., (2009). Group Dynamics and Team Building. 3rd Edition, McGraw-Hill Publisher, U.S.A, New York.
- [31] Naydeck, B., Pearson J., (2009). "The impact of the highmark employee wellness programs on 4-year healthcare costs." Journal of Occupational and Environmental Medicine/American College of Occupational and Environmental Medicine 2, 46-56.
- [32] Nielsen, P., Poul A., (2013). Performance Management, Managerial Authority, and Public Service Performance. Journal of Public Administration Research and Theory, 4, 34-40.
- [33] O'Donnell, M., (2009). Definition of health promotion. Embracing passion, enhancing motivation, recognizing dynamic balance, and creating opportunities. American Journal of Health Promotion, 24(1). 27-37.
- [34] Ongeri B., (2013). The Role of Kenya's Listed Commercial Banks in Economic Growth. 2nd Edition, East Africa Education Publishers. Kenya. Nairobi.
- [35] Ongore, V., (2011). The relationship between ownership structure and firm performance. An empirical analysis of listed companies in Kenya. African Journal of Business Management, 5(6), 21-28.
- [36] Osayameh, R., (2011). Practice of Banking, Lending and Finance, 2nd edition, East Africa Education Publishers. Kenya, Nairobi.
- [37] Osilla, K. C., K. Van Busum (2012). "Systematic review of the impact of worksite wellness programs. The American Journal of Managed Care, 8, 68-81.
- [38] Ozminkowski, R., & Goetzl J., (2009). The impact of the Citibank, NA, health management program on changes in employee health risks over time. Journal of Occupational and Environmental Medicine/American 5, 2-5.
- [39] Parks, K., & Steelman, L., (2008). Organizational Wellness. A Meta-Analysis. Journal on Occupational Health Psychology. 13(1). 58-68.
- [40] Peil, S., (2005). Research Methodology and Design. 5th Edition, Macmillan. Publishers, U.S.A. New York.
- [41] Perry, C., (2010). Work killing employee passion and belief in self. 1st Edition, UK, London.
- [42] Pocock, B., Skinner, N., Pianiello, S., (2010). Working hours, holidays and working life: 1st Edition. Iowa Publishers. U.S.A. Iowa State.
- [43] PriceWaterhouse Cooper (2007). Working towards wellness. Accelerating the prevention of chronic disease. World Economic Forum. Geneva.
- [44] Purath, J., & Miller, M., (2009). A brief intervention to increase physical activity in sedentary working women. The Canadian Journal of Nursing Research, 6, 76-91.
- [45] Racette, S. B., S. S. Deusinger (2009). Worksite Opportunities for Wellness. 4th Edition. McGraw-Hill Publisher. U.S.A. New York.
- [46] Rath, T., & Harter, J., (2010). The Economics of Wellbeing. 5th Edition. Macmillan. Publishers. U.S.A. New York.
- [47] Robert W., (2012). How can the United States keep employee-related health care costs under control? 1st Edition, Foresight Publisher. U.S.A. Ohio.
- [48] Schmidt, H., (2012). Wellness incentives, equity, and the 5 groups problem. American Journal of Public Health. 10, 49-54.
- [49] Schultz, Duane P., Schultz, Sydney, Ellen, (2010). Psychology and work today 1st Edition. Pitman Publication. U.K. London.
- [50] Siegel, J., Prelep M., (2010). A worksite obesity intervention. Results from a group-randomized trial. American Journal of Public Health, 10, 27-33.
- [51] Tatom, J. A. (2010). Financial well-being and some problems in assessing its link to financial education. 1st Edition. McGraw-Hill Publisher. U.S.A. New York.
- [52] Taylor, S., & Don, M., (2010). Financial Planning. 4th Edition. College Press. USA. Boston.
- [53] Terry, P., & Fowles, J., (2011). Comparing a traditional worksite health promotion program. 1st Edition. Pitman Publication. U.K. London.
- [54] Thompson, E., Phua, F., (2012). A Brief Index of Affective Job Satisfaction. Group & Organization Management, 37 (3), 275-307.
- [55] Tu, H., & Mayrell, R., (2010). Employer Wellness Initiatives Grow, But Effectiveness Varies Widely. National Institute for Health Care Reform. 1st Edition, Iowa Publishers. U.S.A. Iowa.
- [56] Wegge, J., Van D., Fisher, G., West, M., Dawson, J., (2006). A Test of Basic Assumptions of Affective Events Theory (AET) in Work Call Centre. British Journal of Management . 17 (3), 237-254.
- [57] World Bank, (2013). Investing in a Sustainable Workforce. Pitman Publishers. U.S.A. Washington D.C.
- [58] World Economic Forum, (2012). The Workplace Wellness Alliance. Investing in a Sustainable Workforce. Pitman Publishers. Switzerland, Geneva.
- [59] World Economic Forum, (2010). The Wellness Imperative. Creating More Effective Organizations. Pitman Publishers. Switzerland, Geneva.
- [60] Zikmund, W., (2010). Business Research Methods 8th Edition. McGraw-Hill Publishers. U.S.A. New York.

AUTHORS

First Author: Ben Bett Tuwai, Masters Degree in Human Resource Management, benbett2003@gmail.com, Jomo Kenyatta University of Agriculture and Technology
Second Author: Cyrus Kamau, Bachelor Degree in Purchasing and Supplies, chiefkanaz@yahoo.com, Kenya Institute of management.
Third Author: Samson Kuria, Masters Degree in Project Management, skanaik@gmail.com, Nairobi University,
Correspondent Author: James Gitau, Bachelor Degree Business Administration, muchigas@gmail.com, Kenya Methodist University

Introduction to Mobile Ad Hoc Network

Ms. Amita Pandey

Department of E. & c., Universal College of Engg. & Techno., Gujarat, India

Abstract- Wireless network consist of wireless node without any administration. Due to present of mobility of nodes, the network is easily personated by several attacks. In 1980's Mobile ad hoc network s have been widely researched ` for many years. Ad hoc network is a collection of nodes that is connected through a wireless medium forming rapidly changing topologies .The infrastructure less and dynamic nature of these network demands new set of networking strategies to be implemented in order to provide efficient end to end communication. Wireless devices are constantly grooving in communication field having more computing speed and a number of features, while shrinking in weight and size. The ad hoc network is made up of multiple nodes connected by links since link can be connected as well as disconnected at any time. The ad hoc network inherits the some traditional problem of mobile communication as well as wireless. Routing in mobile ad hoc networks in challenges task due to its frequent changes in topology. We discuss in this paper routing protocol, challenges and security of ad hoc network

Index Terms- Ad-hoc network, Routing Protocol, MANET Attacks, Challenges Application

I. INTRODUCTION

Mobile ad-hoc network is a collection of wireless mobile host without fixed infrastructure and centralized administration (figure1).Communication in MANET is done via multi hope paths. Lots of challenges are there in this area: MANET contains diverse resources the line of defence is very ambiguous; Nodes operate in shared wireless medium, network topology changes unpredictably and very dynamically, Radio link reliability is an issue, connection breaks are pretty frequent moreover density of nodes, number of nodes and mobility of hosts may vary in different applications, There is no stationary infrastructure. Each node in MANET acts as router those forward data packets to other nodes.

Higher flexibility and scalability in ad-hoc motivate many application. Nodes in ad hoc network are self -organized, these will require higher security over network. Due to limited communication and communication resources it becomes difficult to provide security for ad-hoc network. Group communication for is common for ad-hoc network which require data to be transmitted in a secure and trusted manner. To provide network security has to achieve security goals (1) Confidentially, to prevent unauthorized from reading transmitted dated, (2) Message authentication used to prevent tempering with transmitted packet. Source message authentication is the corroboration that message has not been changed and the sender of a message is as claimed to be, this can be done by(1) cryptographic digital signature(2) message authentication code,

First involve asymmetric cryptography and often needs heavy computation at the sender and receiver. The MAC implicitly ensures message and source integrity. In unicast, a shared security system used for MAC generation. Many challenges are involved to provide group communication in ad hoc network; nodes in ad-hoc network have limited computing, bandwidth, and energy resources which make the overhead. Second due to unstable wireless links due to interference cause frequent packet loss error and require a security solution that includes retransmission and reply over the packet loss. Third use of same common key will make a problem of impersonating source by any receiver, so solution has to be made for using multiple authentications over the network without overhead. This paper propose a two tire authentication scheme

For multicast traffic for ad hoc network, the nodes are grouped into cluster in order to cut overhead and provide scalability. Multicast traffic with in the same cluster employ a one way has function to authenticate the message source. The message authentication code is appended to message and the authentication key is revealed after the message is delivered which is used to message authentication sources. Cluster would make it possible to keep the node synchronized and address the variance in forwarding delay issue of message authentication within a cluster. Cross-cluster includes message authentication code (MACs) that are based on multiple keys. Each cluster has distinct combination of MACs in the message in order to authenticate the source.

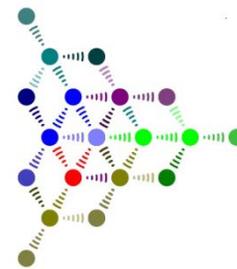


Figure 1: A mobile Ad Hoc Network

Network centric warfare broadly describe the combination of strategies ,emerging tactics, techniques procedures and organisations, which even partially networked force to gain a decisive war fighting advantage Network centric warfare should be supported with capabilities such as mobility, security, survivability, and is capable of supporting multimedia tactical information This require the importance of secure, integrated and efficient networking in digital battle field (DBFs) which may be comprised of various critical networking component including satellites ,terrestrial units and tactical operation centre. Among

them military Mobile Ad-hoc networks (MANETS) gain a special importance for the future combat system.

II. RELATED WORK

Many existing security solutions for conventional networks are ineffective and inefficient ad hoc networks. Consequently, researcher have been working for the last decade on developing new security solutions or changing current ones to be applicable to ad-hoc network. In literature several approaches have been developed Multicast security. Taxonomy and efficient construction, in this approach sources appends MACs for multicast keys so that a receiver verifies the authenticity of message without being able to forge the MACs the other nodes. The challenges in using this category of approaches are striking the balance between collision overheads and performance. Use of distinct MAC per node will create bandwidth overhead and if same key is used it will make risk over nodes collision. Efficient authentication and signing of multicast streams over loss channels TESLA is very popular example this category. One of the most distinct advantage of time asymmetry is the minimal per packet overhead that they impose. However, it requires clock synchronization among the communication parties in order to prevent accepting forged packet, or discarding authentic packet. But for large network forwarding delay will force the node to limit the packet transmission rates to avoid revealing next keys to intermediate nodes before all receivers get all previously transmitted packet.

Scalable Multicast rout is proposed, constructing a shared bi-directional multicast tree to avoid network partitioning. Protocol is based on the location information obtained employing relevant data structure. Two tired hierarchical strategy was proposed that combines both time and secret information asymmetry in order to achieve scalability and resource efficiency. Deliver multicast data reliably with minimal network overhead. No requirement of maintaining any tree or mesh likes structure for multicasting. Delivering data reliably in both sparse network and dense network efficient and scalable multicasting (ESM) was proposed.ESM used source to receiver expansion approach made a balance between multicast group and overhead. An Ad-hoc network is a network consist collection of nodes, which can communicate with each other with any Centralized infrastructure. Nodes within ad hoc are mobile. They can communicate with each within radio range through direct wireless links. They also communicate through other nodes

They are self-organizing. There is no infrastructure. They providing communication when a network is not available or not considered to be secure or safe to use an existing infrastructure and also providing a communication network when existing network is not available or destroyed they uses in personal are network like as Mobile phone, laptop etc.

In this study, in order to address the problem, we propose anew multi –tier adoptive military MANET security protocol using hybrid cryptography and sign crypt ion. In our protocol, we particularly focus on the secure multicast concept to provide secure and instant communication in digital battle field (DBF). In order to provide security and efficiency simultaneously, we make county buttons to the military MANETS for three main areas: Structural design of the military MANET a, cryptographic

methods used in MANETs and integrated key management technique. These are particularly selected, since they are essential factors that determine security and performance characteristics of military MANETs, We use amulet-tired network structure, which provides advantage for structure organization of military MANETs. Two tired unmanned Ariel Vehicle- Mobile Backbone Networks (UAV-MBN) have been recently proposed for DBFs exploiting the heterogeneous structure of MANETs. In our protocol, as a new approach, we divide MBN tier into MBN1 and MBN2 tiers. This is significantly facilitating key management since it encapsulates effects of the rekeying operation in the restricted sub-theatres. It also utilizes some benefits of MBN1 type nodes and facilities certifications procedure in the MBN tier by reducing the threshold cryptography requirements.

III. APPLICATION AND LIMITATION OF MANET

It is easy to imagine a number of applications where this type of properties would bring benefits. One interesting research area id inter-vehicle communications. It is one area where the ad-hoc network could really change the way we communicate covering personal vehicle as well as professional mobile communication needs. Also, it is area where no conventional (i.e. wired) solutions would do because of high level of mobility. When considering demanding surrounding, say mines for example, then neither would the base station approach work but we must be able to accomplish routing via nodes that are part of the network i.e. we have to use ad-hoc network. Such network can be used to enable next generation of battlefield applications envisioned by the military including unmanned micro-sensor networks. Ad hoc networks can provide communication for civilian application, such as disaster recovery and message exchange among medical and security personal involved in rescue mission

Military sector: military equipment routinely contains some short of computer equipment. Ad-hoc networking would allow the military to take advantage of complete network technology to maintain an information network between the soldier vehicle and military information headquarters. The basic technique came from this field.

Commercial Sector: Ad hoc can be used in emergency/risqué operation for disaster relief efforts, e.g. in fire, flood and earth quake. This may be because all of equipment was destroyed, or perhaps because the region is too remote Rescuers must be able- to communicate in order to make the best use of their energy, but also to maintain to safety .By automatically establishing a data network with the communication equipment that the rescuer are already carrying, their job made easier. Other commercial scenarios include ship to ship ad hoc mobile communication, law enforcement, etc.

A. Low level:

Appropriate low level application might be in home networks where device can communicate directly to exchange information. Similarly in other civilian environments like taxicab, sports stadium boat and small air craft, mobile ad hoc communication will have much application.

B. Data Network:

A commercial application for MANETs includes ubiquitous computing. By allowing computers to forward data for others,

data network may be extended for beyond the usual reach of installed infrastructure. Network may be made more widely available and easier to use.

C. Sensor Network:

This technology is a network composed of a very large number of small sensors. These can be used to detect any number of properties of an area. Examples include temperature, pressure, toxin, pollution, etc. The capabilities of each sensor are very limited, and each must rely on other in order to forward data to a central computer. Individual sensors are limited in their computing capability and are prone to failure and loss. Mobile ad hoc networks could be the key to future homeland security.

D. Temporal dependency:

Due to physical constrains of the mobile entity itself, the velocity of mobile node will change continuously and gently instead of abruptly, i.e. the current velocity is dependent on the previous velocity. However, intuitively, the velocity at two different time slots is independent in random waypoint model.

E. Spatial dependency:

The movement pattern of mobile node may be influenced by and correlated with nodes in its neighbour-hood. In random waypoint, each mobile node moves independently of order.

F. Geographic restriction:

In many cases, the movement of a mobile node may be restricted along the street or a freeway. A geo-graphic map may define these boundaries.

IV. SECURITY PROBLEM IN MANET

MANETS are much more vulnerable to attack than wired network. This is because of the following reason:

A. Open medium-

Eavesdropping is easier than in wired network.

B. Lack of centralized Monitoring-

Absence of any centralized prohibits any monitoring agent in the system.

C. Lack of clear line of defence

The only use of line of defense attack prevention may not use, Experience of security research in wired world has taught us that we need to deploy layered security mechanism because security is a process that is as secure as its weakest link. In addition to prevention, we need II line of defense detection and response.

D. Cooperative Algorithm-

The algorithm of MANET requires mutual trust between nodes which violates the principle of Network

V. ADVANTAGE

The following are the advantage of MANETs; they provide access to information and service regardless of geographic position. This network can be setup at any place and time. These networks work without any preexisting infrastructure.

VI. DISADVANTAGE

Some of the disadvantage of MANETs are; limited resources, limited physical security, and intrinsic mutual trust

vulnerable to attacks. Lack of authorization facilities volatile network topology makes it hard to detect malicious nodes Security protocols for wired networks cannot work for ad hoc networks.

VII. CHALLENGE IN MANET

A. Autonomous-

No centralized administration entity is available to manage the operation of the different mobile nodes

B. Dynamically a Changing Network Topology

Mobile node come and goes from the network there by allowing any malicious node to join the network without being detected.

C. Device discovery-

Identifying relevant newly moved in nodes and informing about their existence need dynamic update to facilitate automatic optimal route selection.

D. Bandwidth optimization:

Wireless linked has lower capacity than the wired network. Routing protocols in wireless network always use the bandwidth in an optimal manner by keeping the overhead as low as possible. The limited transmission range also imposes constrained on routing protocols in maintaining the topological information. Especially in MANETs due to frequent change topological information at all nodes involves more control overhead which, in turn, more bandwidth wastage.

E. Limited Resources :

Mobile nodes rely on battery power, which is a scare resource; also storage capacity and power are severely limited.

F. Scalability:

Scalability can broadly define as whether the network is able to provide an acceptable level of service even in the presence of a large number of nodes

G. Infrastructure less and self-operated:

Ad-hoc networks are supposed to operate independently of any fixed infrastructure.

H. Poor transmission quality:

This is an inherent problem of wireless communication caused by several error source that result in degradation of received signal.

I. Ad-hoc addressing:

Challenges in standard addressing schema to be implemented.

J. Network configuration:

The whole MANET infrastructure is dynamic and is the reason for dynamic connection and dis connection of the variable links.

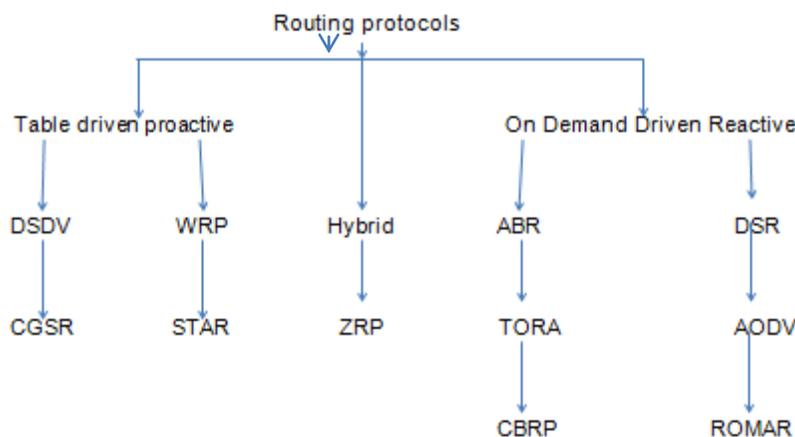
K. Topology maintenance

Updating information of dynamic links among nodes in MANETs is a major challenge

VIII. ROUTING PROTOCOLES

Routing protocols define a set of rules which governs the journey of message packets from source to destination in a network. In MANET there are three types of routing protocols each of them is applied according to the network circumstances.

Figure 1 shows the basic classification of the routing protocols in MANETs



1. Proactive Routing Protocols-

Proactive protocols are also called as table driven protocols. In this each node maintain routing table which contains information about the network topology even without requiring it. The routing table are updated periodically whenever the network topology changes. Proactive protocols are not appropriate for large network as they need to maintain node entries for each and every node.

There various proactive routing protocols. Example: DSDV, OLSR, WRP etc.

2. Reactive Routing Protocols-

Reactive protocol is also known as on demand routing protocol. In type of protocol, rout is discovered whenever it is needed. Node initiates rout discovery when demanded. A rout is acquired by the initiation of a rout discovery process by the source node. This routing protocol has two major components

A. Rout discovery-In this phase source node initiate rout discovery on demand basis. Source node consult its rout cache for the available route from source to destination otherwise if the rout is not present it initiate rout discovery. The packet of source node includes the address of the destination node as well as address of the intermediate node to the destination.

B. Route maintenance-Due to dynamic topology go the network cases of the rout failure between the nodes arises due to

link breakage etc, so rout maintenance is required. Reactive protocol has more acknowledgement mechanism due to which route maintenance is possible.

There are various reactive protocols. Example: DSR, AODV, TORA AND LMR.

3. Hybrid protocol-

This type of routing protocol is trade –off between proactive and reactive protocols. Proactive protocols have more overhead and less latency while reactive protocols overhead and more latency. Thus a hybrid protocols needed to overcome the shouting of both proactive and reactive routing protocols. This protocol is a combination of both proactive and reactive routing protocol. It uses the on demand mechanism of reactive protocol and the table maintenance mechanism of proactive protocol so as to avoid latency and overhead problem in the network. Hybrid protocol is appropriate for large networks where large numbers of nodes are present. In this, large network is divided into a set of zones where routing inside the zone is done by using proactive approach and the zone routing is done routing using reactive approach.

There are various hybrid routing protocols for MANET, like ZRP, SHRP etc.

IX. COMPARISON OF PROTOCOLS

Protocol	Advantage	Disadvantage
Proactive	Information is always available. Latency is reduced in the network	Overhead is high, routing information is flooded in the whole network
Reactive	Path available when needed overhead is low and free from loops	Latency is increased in the Network
Hybrid	Suitable for large networks and up to date information Available	Complexity increases

X. ATTACKS ON MANET

There are various kinds of attacks on ad hoc network which are following:

A. Location Disclosure-

Location disclosure is an attack that targets the privacy requirements of an ad-hoc network. By using traffic analysis techniques, simpler probing and monitoring approaches, an attacker is able to detect the location of node or the structure of the whole network.

B. Black Hole-

In a black hole a malicious node injects false route replies to route requests, announcing it as having the shortest path to a destination. These fake replies can be fabricated to divert network traffic through the malicious node for simply to attract all the traffic towards it in order to perform a denial of service attack by discarding the received packets.

C. Replay-

A replay attack is one of the attacks that degrade severely the performance of MANET. a replay attacker does this attack by interception and retransmission of valid signed messages

D. Wormhole-

The wormhole attack is one of the most powerful presented here since it involves the cooperation between two malicious nodes that participate in the network. One attacker, e.g. node A, capture routing traffic at one point of the network and tunnel them to another point in the network ,to node B, for example that share a private communication link with a. Node B then selectively injects tunneled traffic into the network. The connection between the nodes that have established route over the wormhole link is completely under the control of the two conspiring attackers. The packet leashes are the solution to this attack.

E. Blackmail-

These attacks are relevant against routing protocols that use mechanism for the identification of malicious nodes and propagates messages and try to isolate legitimate node from the network. The non-repudiation security criteria can prove to be usefully in such cases since it binds a node to the message it generated.

F. Denial of Service-

Denial of service attacks aim at the complete disruption of the routing function and therefore the entire operation of the ad hoc network. In a routing tangle overflow attack the malicious node floods the network with bogus route creation packets in order to consume the resources of participating nodes and disrupt the establishment of legal route.

G. Routing –

Table poisoning-Routing protocol maintain table that hold information regarding route of the network. In this type of attack, the malicious node generate and send fabricated signaling traffic or modify legitimate message from the other nodes ,in order to add false entries in the tables of the participating nodes.

H. Breaking the neighbour relationship-

An intelligent filter is placed by an intruder on a communication link between two ISs (information system) could modify or change information in the routing update or even interrupt traffic belonging to any data session.

I. Masquerading-

During the neighbor acquisition process, an outside intruder could masquerade a nonexistence or existing IS by attacking itself to communication link and illegally joining in the routing protocols domain by comprising authentication system .The threat of masquerading is almost the same as that of a compromised IS.J.

J. Impersonation-

Impersonation attacks are a severe threat to the attacker can capture some nodes in the network and make them look like friendly nodes. Thus, the compromised nodes can join the network as the normal nodes and begin to conduct the malicious behaviors such as propagate fake routing information and gain inappropriate priority to access some confidential information

K. Eavesdropping-

It is another kind of attack that usually happens in the mobile ad hoc networks.Eavesdropping means to obtain some confidential information that should be kept secret during the communication. The confidential information may include the public key, private key, location and passwords of the nodes. Because such data are very confidential to the nodes, they should be kept secret so that unauthorized can't access this.

XI. CONCLUSION

In this paper, we describe the infrastructure less Mobile Ad Hoc networks. Firstly the brief introduction was discussed, including the basic idea of MANET. Then the characteristic and application of MANETWERE discussed that helps us to understand more about MANET. Routing protocols were discussed, including its types, example and pros and cons comparison among them .We describe the challenges of MANET, through which we can know the issue in MANET which leads to some problem in this type of networks. Security of MANET is discussed having the brief description of security criteria and then the attack on MANET.

The solution of these issues is necessary to fulfill the requirement of wide commercial deployment of MANET.

Mobile Ad hoc networking is one of the most important and essential technologies that support future computing scheme the characteristic of MANET bring this technology as a great opportunity together with many challenges. Now a day. MANET is becoming an interesting research topic and there are many research projects employed by academic and companies all over the world.

MANETs can be exploited in a wide are of application like military battlefield, emergency search and rescue, law enforcement, commercial, local and personal contexts. The most important thing for the networks is security. It is also important for wireless Ad hoc network because its application is military.

REFERENCES

- [1] Jagtar Singh & Natasha Dhiman, Department of computer Science & Engineering HCTM Technical Campuses, Kaithal, India Vol.2 Issue 4 July 2013.ISSN 2278-621X.
- [2] Ankur Bang, Prabhakar L. Ramteke. MANET: History, Challenges and Applications. Volume 2, issue9, September2013.ISSN2319-4847
- [3] Ms.Ruchica A. Kale and Prof.Dr.S.R. Gupta Department of Computer Science & Engineering PRMIT & R, Bandera vol. 6, No.2, Apr 2013 (IJCSA) ISSN: 0974-1011 (Open Access).
- [4] Malik N. Ahmed, Department of Computer science & Information. System, University Technology Malaysia. Johor, Malaysia. Abdul Hanan Abdullah, Ayman El –Sayed Department of Computer science and Engineering. Menouf, Egypt. VOL. IJCNSS, 2013, 6,176-185
- [5] Mr. Raja, Capt. Department of Computer application, Pachaiyappa 'college, Chfnni30. Dr . S Santosh Baboo. Department of Computer Science, D.G.Vaishnav College, Chennai s106.IJCSMC, Vol.3, Issue.1, January 2014, pg. 408-417.ISSN 2320-088X.
- [6] Stephen Mueller, Department of Computer science, University of California, Davis, CA95616 Rose P. Tsang.and Deepak Ghosal Department of Computer science, University of California, live more, Ca94551 Multipath Routing in Mobile Ad Hoc Network: Issues and Challenge
- [7] H. yang, et al.. Security in mobile Ad-hoc wireless network: Challenges and solutions. IEEE wireless commun.Mag. Vol.11 no.1, pp. 1536-1284 feb 2004
- [8] Turk J Elect Eng. & Comp Sci, Vol.18, No.1, 2010

AUTHORS

First Author – Ms. Amita Pandey, Department of E. & c.,
Universal College of Engg. & Techno, Gujarat, India,
apamitapandey@gmail.com

Questionnaire Survey: For Identifying Most Cost Influencing Parameter In Case Of Road Projects

Guruprasad Chavan*, Amit Sharma**, Ajay Kumar Nirala**

*Department of Civil Engineering, KIT'S COLLEGE OF ENGINEERING, KOLHAPUR.

**Department of Civil Engineering, KIT'S COLLEGE OF ENGINEERING, KOLHAPUR.

**Department of Civil Engineering, KIT'S COLLEGE OF ENGINEERING, KOLHAPUR.

Abstract- Money is the prime importance in case of road projects as huge amount of funds (in trillions) is involved in such projects. The construction industry in India suffers from cost overruns. Various parameters affecting the road project cost. These parameters affect the cost in vast manner so they are responsible for deviation of cost of road projects. Regression analysis is simple technique for determining the influence of these factors on cost of road projects. Identifying and evaluating the factors that influence cost are critical issues faced by construction managers. It is therefore important that factors affecting cost of the road projects are well identified so that efforts can be made to improve the situation. So purpose of this work is, to study the parameters that affect the cost of the road project and to suggest regression analysis technique for evaluating these parameters from the point of view of judging their influence on cost.

Index Terms- Influencing factors, Questionnaire Survey, Questionnaire Survey and regression, Parameters.

I. INTRODUCTION

India has a road network of over 4,236,000 kilometers (2,632,000 mi) in 2011, the third largest road network in the world. At 0.66 km of roads per square kilometer of land, the quantitative density of India's road network is similar to that of the United States (0.65) and far higher than that of China (0.16) or Brazil (0.20). However, qualitatively India's roads are a mix of modern highways and narrow, unpaved roads, and are undergoing drastic improvement. As of 2008, 49 percent – about 2.1 million kilometers – of Indian roads were paved. Adjusted for its large population, India has less than 4 kilometers of roads per 1000 people, including all its paved and unpaved roads. In terms of quality, all season, 4 or more lane highways, India has less than 0.07 kilometers of highways per 1000 people, as of 2010. These are some of the lowest road and highway densities in the world. For context, United States has 21 kilometers of roads per 1000 people, while France about 15 kilometers per 1000 people – predominantly paved and high quality in both cases. In terms of all season, 4 or more lane highways, developed countries such as United States and France have a highway density per 1000 people that is over 15 times as India.

India in its past did not allocate enough resources to build or maintain its road network. This has changed since 1995,

with major efforts currently underway to modernize the country's road infrastructure. India plans to spend approximately US\$70 Billion by 2013 to modernize its highway network. As of October 2013, India had completed and placed in use over 21,300 kilometers of recently built 4 or 6-lane highways connecting many of its major manufacturing centers, commercial and cultural centers. The rate of new highway construction across India has accelerated in recent years. As of October 2011, the country was adding 11 kilometers of new highways, on average, every day. The expected pace of project initiations and completion suggests that India would add about 600 kilometers of modern highway per month, on average, through 2014. Some of the major projects that are being implemented include the National Highways Development Project, Yamuna Expressway and the KMP Expressway. According to 2009 estimates by Goldman Sachs, India will need to invest US\$1.7 trillion on infrastructure projects before 2020 to meet its economic needs, a part of which would be in upgrading India's road network. The government of India is attempting to promote foreign investment in road projects by offering financial incentives. This has led the government to create ambitious targets of building an average of 20kms a day, which according to figures from the NHAI, only 12kms a day has been completed since April 2007. But meeting these targets is imperative in accompanying the growing pace of the country. So the Indian government has moved to financing projects through PPPs – as their overseeing of projects using the government budget was inadequate to assist the required growth. Poor cost performance of construction projects seems to be the norm rather than the exception particularly in most developing countries where the problem is more acute. Road construction is generally undertaken by private companies on B.O.T. basis. Cost estimation is necessary for application of tenders to get a project. Generally, the estimated cost of the project and the actual cost of the project vary to a large extent. This is because; road construction costs depend on a large number of parameters related to construction, climatic conditions, financial status and many other. Questionnaire survey analysis is simple technique for determining the influence of these factors on cost of road projects. As we know the most cost affecting parameter of road projects, we can make feasible improvement in road alignment, design features as well as in selection of site. As a result we can reduce the cost of road projects. In India cost of road and infrastructure projects is most overgrowing issue, due to our economic status as a developing country significant cost

overruns. Road construction is one of the major activities in the construction industry.

II. LITERATURE REVIEW

The various papers that were referred for finding out the factors are as follows-

- 1) Abdullah Alhomidan (2013), had presented a paper on “Factors Affecting Cost Overrun in Road Construction Projects in Saudi Arabia” He took 41 factors causing cost overrun in road construction projects which were defined through a detailed literature review. These causes were classified into 6 groups according to the sources of delay: project, managerial, consultant, external, construction items, and financial. Frequency and severity of each factor is determined by the zone in which they fell i.e yellow, green, red. The survey indicated that the most severe factors affecting cost overrun in road construction projects are: internal administrative problems, payments delay, poor communication between construction parties, and delays in decision making. The results show that most of the critical factors are managerial factors that could be controlled and minimized by improving the managerial skills of the construction teams by conducting proper trainings and workshops
- 2) Bent Flyvbjerg, et all (2004)// they had presented a paper on “What Causes Cost Overrun in Transport Infrastructure Project “. The study is based on a sample of 258 rail, bridge, tunnel, and road project worth US\$90 billion. The focus is on the dependence of cost escalation on (1) length of project implementation phase, (2) size of project and (3) type of project ownership. First it is found with very high statistical significance that cost escalation is strongly dependant on length of implementation phase because they translate into risks of substantial cost escalation. Second, it is found that project have grown larger over time and that for bridges and tunnel larger project have larger percentage cost escalation . finally, by comparing cost escalation for three types of project ownership—private, state owned enterprises and other public ownership—it is shown that the often seen claim that public ownership is problematic and private ownership effective in curbing cost escalation is an oversimplification. Types of accountability appears to matter to the cost escalation than type of ownership.
- 3) Ibrahim Mahamid (2013), he had presented a paper “Common risks affecting time overrun in road construction projects in Palestine: Contractors’ perspective” . His study aims at identifying the common risks affecting time overrun in road construction projects in the West Bank in Palestine from contractors’ viewpoint. 45 factors that might cause delays of road construction projects were defined through a detailed

literature review. A questionnaire survey was performed to rank the considered factors in terms of severity and frequency. The analysis of the survey indicated that the top risks affecting time overrun in road construction projects in Palestine are: financial status of the contractors, payment delays by the owner, the political situation and segmentation of the West Bank, poor communication between construction parties, lack of equipment efficiency and high competition in bids.

- 4) Shri. B.S. Patil ,et all.(2011)// they had presented a paper in international journal as “Factors Affecting The Cost And Quality Of Construction” they highlighted some of the points which are very essential in reducing the cost and delay of project and also remedies. Main causes of time-delays in order are the number of change orders, financial constraints and owners lack of experience in construction. The three main causes of cost overruns on the other hand in order are contractor related problems, material-related problems and, again, owners financial constraints. to minimize, time-delays and cost-overruns and thereby ensuring quality? They should:: (a) ensure adequate and available source of finance; (b) perform a pre-construction planning of project tasks and resource needs; (c) allocate sufficient time and money on the design phase;(d) if cost-effective (depending on the size of the project), hire an independent supervising engineer to monitor the progress and quality of the work and ensure timely delivery of materials; and finally, the most important factor of all, (e) select a competent consultant and a reliable contractor to carry out the work.

III. METHODOLOGY

In this research work Questionnaire survey is used as a tool to find out the various factors and most influencing parameter, also this survey hands a systematic approach and an easy format through which all the parameter are covered and can be easily assessed.

- A) The procedure followed is as follows
 1. As a first step, cost influencing parameters are well identified thorough literature review, data collected from various govt. authorities, contractors, site engineers, supervisors and labour supervisors
 2. A structured questionnaire was prepared considering all the above factors and they were arranged in a descending order according to their repetition by majority of people.
 3. Each factor was given a scale of 0 to 10, so that the person could express the severity of impact by an individual factor on cost i.e. 0 being the lowest and 10 being the highest.
 4. The whole scale was divided into two parts
 - 1) 0 to 4 - least influencing.

2) 5 to 10 – most influencing.

5. A total of 85 questionnaires were distributed and collected from various govt. authorities, contractors, site engineers, supervisors and labour supervisors.
6. The scale value obtained by the individual factors from 85 questionnaires was noted down in table I and II.
7. These values obtained from the questionnaires were analyzed on the basis of mean and coefficient of variance.

IV. FACTORS

The Factors were collected from literature review Apart from that, collected from various govt. Authorities like PWD, Zilla Parishad, PMGSY etc, local govt. and private contractor, site engineers, site supervisors etc. list of 29 factors that were included in the questionnaire is given below.

The 29 factors are as follows;-

- 1) Terrain Condition
- 2) Land Acquisition
- 3) Road Length
- 4) Soil & Rock Suitability / Drillability
- 5) Traffic Intensity
- 6) Material Related Problem (Transportation, Cost, Handling Etc.)
- 7) Project Size / Phases
- 8) Payment Related Problem From Owner Side
- 9) Poor Communication Between Construction Parties
- 10) Lack Of Equipment Efficiency (Efficiency Of Operator, Suitability Of Particular Equipment To Site Condition)
- 11) Climatic Condition
- 12) Drainage Problem
- 13) Road Width
- 14) Financial Status Of Contractor
- 15) Lack Of Experience & Knowledge Of Construction Parties
- 16) Local Issues
- 17) Labour Availability
- 18) Involvement Of More No. Of Parties (Contractor) In Single Project
- 19) Lack Of Efficiency Of Contractor To Achieve Time Goal Of Project
- 20) Availability Of Modern Equipment & Methods
- 21) Alignment Of Road
- 22) Technicality Involved (Method of Construction)
- 23) Time (Delay In Project Completion Affect Overall Procurement Cost, Labour Cost, Equipment Cost Etc.)
- 24) Thickness Of Various Layers In Case Of Flexible Pavement (WBM, BBM, BM)
- 25) No. Of Cross Drainage Works
- 26) Application Of Geotextile Membrane In Road Construction
- 27) Poor Site Management
- 28) Conflict Among Project Participants
- 29) Re Work Due To Poor Material Quality Used Before

IV. STRUCTURED QUESTIONNAIRE

The structured questionnaire was prepared by taking into consideration all the above 29 factors, along with few more blank points for any other factors which would be included by the technical persons. The questionnaire is prepared with each and every factors having a scale of 0 to 10 (0 meaning the lowest & 10 meaning the highest). The purpose of scaling the factor is to understand the intensity of impact that the factor would produce on the cost of the project according to the respective person. Below is the prepared structured questionnaire.

[Q.S.:-]

QUESTIONNAIRE SURVEY

PROJECT TITLE: Questionnaire Survey: For Identifying Most Cost Influencing Parameters in case of road Projects.

DATE : / / 2014

(To be filled by concerned Authority)

Following are the Cost influencing Factor in case of Road Projects. Give the Rating in between 0 to 10 as per your opinion.

1. TERRAIN CONDITION

0 1 2 3 4 5 6 7 8 9 10

2. LAND ACQUISITION

0 1 2 3 4 5 6 7 8 9 10

3. ROAD LENGTH

0 1 2 3 4 5 6 7 8 9 10

4. SOIL & ROCK SUITABILITY / DRILLABILITY

0 1 2 3 4 5 6 7 8 9 10

5. TRAFFIC INTENSITY

0 1 2 3 4 5 6 7 8 9 10

6. MATERIAL RELATED PROBLEM (Transportation, Cost, Handling etc.)

0 1 2 3 4 5 6 7 8 9 10

7. PROJECT SIZE / PHASES

0 1 2 3 4 5 6 7 8 9 10

8. PAYMENT RELATED PROBLEM FROM OWNER SIDE

- 0 1 2 3 4 5 6 7 8 9 10
9. POOR COMMUNICATION BETWEEN CONSTRUCTION PARTIES.
- 0 1 2 3 4 5 6 7 8 9 10
10. LACK OF EQUIPMENT EFFICIENCY (Efficiency of Operator, suitability of particular equipment to site condition)
- 0 1 2 3 4 5 6 7 8 9 10
11. CLIMATIC CONDITION
- 0 1 2 3 4 5 6 7 8 9 10
12. DRAINAGE PROBLEM
- 0 1 2 3 4 5 6 7 8 9 10
13. ROAD WIDTH
- 0 1 2 3 4 5 6 7 8 9 10
14. FINANCIAL STATUS OF CONTRACTOR
- 0 1 2 3 4 5 6 7 8 9 10
15. LACK OF EXPERIENCE & KNOWLEDGE OF CONSTRUCTION PARTIES
- 0 1 2 3 4 5 6 7 8 9 10
16. LOCAL ISSUES
- 0 1 2 3 4 5 6 7 8 9 10
17. LABOUR AVAILABILITY
- 0 1 2 3 4 5 6 7 8 9 10
18. INVOLVEMENT OF MORE NO. OF PARTIES (CONTRACTOR) IN SINGLE PROJECT
- 0 1 2 3 4 5 6 7 8 9 10
19. LACK OF EFFICIENCY OF CONTRACTOR TO ACHIEVE TIME GOAL OF PROJECT
- 0 1 2 3 4 5 6 7 8 9 10
20. AVAILABILITY OF MODERN EQUIPMENT & METHODS
- 0 1 2 3 4 5 6 7 8 9 10

21. ALIGNMENT OF ROAD
- 0 1 2 3 4 5 6 7 8 9 10
22. TECHNICALITY INVOLVED (Method of Construction)
- 0 1 2 3 4 5 6 7 8 9 10
23. TIME (Delay in project Completion Affect Overall Procurement Cost, Labour Cost, Equipment cost etc.)
- 0 1 2 3 4 5 6 7 8 9 10
24. THICKNESS OF VARIOUS LAYERS IN CASE OF FLEXIBLE PAVEMENT (WBM, BBM, BM)
- 0 1 2 3 4 5 6 7 8 9 10
25. NO. OF CROSS DRAINAGE WORKS
- 0 1 2 3 4 5 6 7 8 9 10
26. APPLICATION OF GEOTEXTILE MEMBRANE IN ROAD CONSTRUCTION
- 0 1 2 3 4 5 6 7 8 9 10
27. POOR SITE MANAGEMENT
- 0 1 2 3 4 5 6 7 8 9 10
28. CONFLICT AMONG PROJECT PARTICIPANTS
- 0 1 2 3 4 5 6 7 8 9 10
29. RE WORK DUE TO POOR MATERIAL QUALITY USED BEFORE
- 0 1 2 3 4 5 6 7 8 9 10
-
- ANY OTHER.....
30. -----
- 0 1 2 3 4 5 6 7 8 9 10
31. -----
- 0 1 2 3 4 5 6 7 8 9 10
32. -----
- 0 1 2 3 4 5 6 7 8 9 10

NAME OF INDUSTRY / ORGANIZATION : -----

NAME OF SIGNATORY : -----

DESIGNATION : -----

DATE :

PLACE :

SEAL :

SIGNATURE :

$$\sigma = \sqrt{\left(\frac{X^2}{N} - \left(\frac{X}{N}\right)^2\right)}$$

- 4) At last the coefficient of variance (C.V.) of individual factors was calculated by following formula.

$$C.V = \frac{\sigma}{X}$$

- 5) The C.V. for a single variable aims to describe the dispersion of the variable in a way that does not depend on the variable's measurement unit. The higher the CV, the greater the dispersion in the variable. The CV for a model aims to describe the model fit in terms of the relative sizes of the squared residuals and outcome values. The lower the C.V., the smaller the residuals relative to the predicted value. This is suggestive of a good model fit.

Based on the mean value obtained by the individual factors the factor getting the higher value was selected as the most cost influencing factor and these factors were arranged in ascending order.

V. ANALYSIS

The Analysis was carried out in two stages i.e.

- 1) Lower scale analysis
- 2) Higher scale analysis

The procedure for the analysis is as follows-

- 1) The total sum of the individual factor was calculated by multiplying the scale value to the no. of times the factor got the same scale value in 85 questionnaires.
- 2) This total was then divided with number of questionnaire and the mean (X) was obtained

$$X = \frac{TOTAL}{N}$$

- 3) After mean, standard deviation (σ) was calculated from the following formula given below

Table I: lower scale analysis

FACTORS	Scaling coefficient					TOTAL	MEAN X	S.D σ	C.V
	0	1	2	3	4				
Terrain Condition	0	3	8	7	11	84	0.99	0.11	10.78
Land Acquisition	0	4	6	7	4	53	0.62	0.07	10.78
Road Length	4	5	8	12	5	77	0.91	0.10	10.78
Soil & Rock Suitability / Drillability	0	3	4	9	11	82	0.96	0.10	10.78
Traffic Intensity	1	3	2	7	4	44	0.52	0.06	10.78
Material Related Problem (Transportation, Cost, Handling Etc.)	0	3	3	7	9	66	0.78	0.08	10.78
Project Size / Phases	1	3	1	16	15	113	1.33	0.14	10.78
Payment Related Problems From Owner Side	0	1	12	13	8	96	1.13	0.12	10.78
Poor Communication Between Construction Parties	5	6	9	13	13	115	1.35	0.15	10.78
Lack Of Equipment Efficiency(Efficiency Of Operator, Suitability Of Particular Equipment To Site Condition)	0	1	7	11	5	68	0.80	0.09	10.78
Climatic Condition	1	1	5	10	11	85	1.00	0.11	10.78

Drainage Problems	1	7	6	8	13	95	1.12	0.12	10.78
Road Width	4	6	8	17	5	93	1.09	0.12	10.78
Financial Status Of Contractor	4	5	7	9	11	90	1.06	0.11	10.78
Lack Of Experience & Knowledge Of Construction Parties	1	3	5	7	15	94	1.11	0.12	10.78
Local Issues	1	3	7	13	7	84	0.99	0.11	10.78
Labour Availability	2	3	6	3	7	52	0.61	0.07	10.78
Involvement Of More No. Of Parties (Contractor) In Single Project	1	8	8	12	11	104	1.22	0.13	10.78
Lack Of Efficiency Of Contractor To Achieve Time Goal Of Project	0	3	5	12	10	89	1.05	0.11	10.78
Availability Of Modern Equipment & Methods	0	2	5	9	7	67	0.79	0.08	10.78
Alignment Of Road	1	4	1	4	11	62	0.73	0.08	10.78
Technicality Involved(Method Of Construction)	0	2	10	3	12	79	0.93	0.10	10.78
Time (Delay In Project Completion Affect Overall Procurement Cost Labour Cost, Equipment Cost Etc.)	0	2	0	2	16	72	0.85	0.09	10.78
Thickness Of Various Layers In Case Of Flexible Pavement(Wbm,Bbm,Bm)	2	5	0	9	8	64	0.75	0.08	10.78
No. Of Cross Drainage Work	3	1	7	4	9	63	0.74	0.08	10.78
Application Of Geotxtile Membrane In Road Construction	4	4	6	5	6	55	0.65	0.07	10.78
Poor Site Management	0	2	6	3	11	67	0.79	0.08	10.78
Conflict Among Project Participants	2	3	2	20	13	119	1.40	0.15	10.78
Re Work Due To Poor Material Quality Used Before	4	1	6	9	13	92	1.08	0.12	10.78

Table II: Higher Scale Analysis

Factors	Scaling Coefficient						Total	Mean X	S.D σ	C.V
	5	6	7	8	9	10				
Terrain Condition	11	7	9	10	8	7	382	4.49	0.48	10.8
Land Acquisition	15	11	8	7	11	7	422	4.96	0.54	10.8
Road Length	11	5	5	10	7	6	323	3.8	0.41	10.8
Soil & Rock Suitability / Drillability	13	6	9	8	11	5	377	4.44	0.48	10.8
Traffic Intensity	14	10	11	9	10	13	499	5.87	0.63	10.8
Material Related Problem (Transportation, Cost, Handling Etc.)	12	18	6	12	4	5	392	4.61	0.5	10.8
Project Size / Phases	11	14	8	7	3	2	298	3.51	0.38	10.8
Payment Related Problems From Owner Side	11	9	8	11	4	4	329	3.87	0.42	10.8
Poor Communication Between Construction Parties	7	6	8	4	3	5	236	2.78	0.3	10.8

Lack Of Equipment Efficiency(Efficiency Of Operator, Suitability Of Particular Equipment To Site Condition)	10	17	8	13	2	5	380	4.47	0.48	10.8
Climatic Condition	6	11	10	10	4	11	392	4.61	0.5	10.8
Drainage Problems	9	9	11	8	0	10	340	4	0.43	10.8
Road Width	8	8	8	12	3	3	297	3.49	0.38	10.8
Financial Status Of Contractor	9	7	14	7	3	3	298	3.51	0.38	10.8
Lack Of Experience & Knowledge Of Construction Parties	9	8	8	16	3	3	334	3.93	0.42	10.8
Local Issues	11	13	11	6	3	5	335	3.94	0.42	10.8
Labour Availability	13	14	7	11	8	7	428	5.04	0.54	10.8
Involvement Of More No. Of Parties (Contractor) In Single Project	7	9	16	5	1	1	260	3.06	0.33	10.8
Lack Of Efficiency Of Contractor To Achieve Time Goal Of Project	16	9	7	9	3	6	342	4.02	0.43	10.8
Availability Of Modern Equipment & Methods	4	17	13	17	5	5	444	5.22	0.56	10.8
Alignment Of Road	11	11	11	13	5	10	447	5.26	0.57	10.8
Technicality Involved(Method Of Construction)	11	12	6	13	10	4	403	4.74	0.51	10.8
Time (Delay In Project Completion Affect Overall Procurement Cost Labour Cost, Equipment Cost Etc.)	10	12	10	7	12	9	446	5.25	0.57	10.8
Thickness Of Various Layers In Case Of Flexible Pavement(Wbm,Bbm,Bm)	5	6	19	9	12	7	444	5.22	0.56	10.8
No. Of Cross Drainage Work	8	13	8	15	4	6	390	4.59	0.49	10.8
Application Of Geotxtile Membrane In Road Construction	10	12	16	6	4	6	378	4.45	0.48	10.8
Poor Site Management	19	8	13	5	8	6	406	4.78	0.52	10.8
Conflict Among Project Participants	8	14	7	2	1	4	238	2.8	0.3	10.8
Re Work Due To Poor Material Quality Used Before	8	10	7	9	7	7	354	4.16	0.45	10.8

VI. RESULT

Table III: lower scale analysis

FACTORS	Scaling coefficient					TOTAL	MEAN X	S.D σ	C.V
	0	1	2	3	4				
Conflict Among Project Participants	2	3	2	20	13	119	1.40	0.15	10.78
Poor Communication Between Construction Parties	5	6	9	13	13	115	1.35	0.15	10.78
Project Size / Phases	1	3	1	16	15	113	1.33	0.14	10.78
Involvement Of More No. Of Parties (Contractor) In Single Project	1	8	8	12	11	104	1.22	0.13	10.78
Payment Related Problems From Owner Side	0	1	12	13	8	96	1.13	0.12	10.78
Drainage Problems	1	7	6	8	13	95	1.12	0.12	10.78

Lack Of Experience & Knowledge Of Construction Parties	1	3	5	7	15	94	1.11	0.12	10.78
Road Width	4	6	8	17	5	93	1.09	0.12	10.78
Re Work Due To Poor Material Quality Used Before	4	1	6	9	13	92	1.08	0.12	10.78
Financial Status Of Contractor	4	5	7	9	11	90	1.06	0.11	10.78
Lack Of Efficiency Of Contractor To Achieve Time Goal Of Project	0	3	5	12	10	89	1.05	0.11	10.78
Climatic Condition	1	1	5	10	11	85	1.00	0.11	10.78
Terrrain Condition	0	3	8	7	11	84	0.99	0.11	10.78
Local Issues	1	3	7	13	7	84	0.99	0.11	10.78
Soil & Rock Suitability / Drillability	0	3	4	9	11	82	0.96	0.10	10.78
Technicality Involved (Method Of Construction)	0	2	10	3	12	79	0.93	0.10	10.78
Road Length	4	5	8	12	5	77	0.91	0.10	10.78
TIME (Delay In Project Completion Affect Overall Procurement Cost Labour Cost, Equipment Cost Etc.)	0	2	0	2	16	72	0.85	0.09	10.78
Lack of equipment efficiency (Efficiency Of Operator, Suitability Of Particular Equipment To Site Condition)	0	1	7	11	5	68	0.80	0.09	10.78
Availability Of Modern Equipment & Methods	0	2	5	9	7	67	0.79	0.08	10.78
Poor Site Management	0	2	6	3	11	67	0.79	0.08	10.78
Material related problem (Transportation, Cost, Handling Etc.)	0	3	3	7	9	66	0.78	0.08	10.78
Thickness Of Various Layers In Case Of Flexible Pavement (WBM,BBM,BM)	2	5	0	9	8	64	0.75	0.08	10.78
No. Of Cross Drainage Work	3	1	7	4	9	63	0.74	0.08	10.78
Alignment Of Road	1	4	1	4	11	62	0.73	0.08	10.78
Application Of Geotxtile Membrane In Road Construction	4	4	6	5	6	55	0.65	0.07	10.78
Land Acquisition	0	4	6	7	4	53	0.62	0.07	10.78
Labour Availability	2	3	6	3	7	52	0.61	0.07	10.78
Traffic Intensity	1	3	2	7	4	44	0.52	0.06	10.78

Table IV: higher scale analysis

Factors	Scaling Coefficient						Total	Mean X	S.D σ	C.V
	5	6	7	8	9	10				
Traffic Intensity	14	10	11	9	10	13	499	5.87	0.63	10.8
Alignment Of Road	11	11	11	13	5	10	447	5.26	0.57	10.8
TIME(Delay In Project Completion Affect Overall Procurement Cost Labour Cost, Equipment Cost Etc.)	10	12	10	7	12	9	446	5.25	0.57	10.8
Availability Of Modern Equipment & Methods	4	17	13	17	5	5	444	5.22	0.56	10.8
Thickness Of Various Layers In Case Of Flexible Pavement (WBM,BBM,BM)	5	6	19	9	12	7	444	5.22	0.56	10.8
Labour Availability	13	14	7	11	8	7	428	5.04	0.54	10.8
Land Acquisition	15	11	8	7	11	7	422	4.96	0.54	10.8
Poor Site Management	19	8	13	5	8	6	406	4.78	0.52	10.8
Technicality Involved (Method Of Construction)	11	12	6	13	10	4	403	4.74	0.51	10.8

Material Related Problem (Transportation, Cost, Handling Etc.)	12	18	6	12	4	5	392	4.61	0.5	10.8
Climatic Condition	6	11	10	10	4	11	392	4.61	0.5	10.8
No. Of Cross Drainage Work	8	13	8	15	4	6	390	4.59	0.49	10.8
Terrain Condition	11	7	9	10	8	7	382	4.49	0.48	10.8
Lack Of Equipment Efficiency(Efficiency Of Operator, Suitability Of Particular Equipment To Site Condition)	10	17	8	13	2	5	380	4.47	0.48	10.8
Application Of Geotxtile Membrane In Road Construction	10	12	16	6	4	6	378	4.45	0.48	10.8
Soil & Rock Suitability / Drillability	13	6	9	8	11	5	377	4.44	0.48	10.8
Re Work Due To Poor Material Quality Used Before	8	10	7	9	7	7	354	4.16	0.45	10.8
Lack Of Efficiency Of Contractor To Achieve Time Goal Of Project	16	9	7	9	3	6	342	4.02	0.43	10.8
Drainage Problems	9	9	11	8	0	10	340	4	0.43	10.8
Local Issues	11	13	11	6	3	5	335	3.94	0.42	10.8
Lack Of Experience & Knowledge Of Construction Parties	9	8	8	16	3	3	334	3.93	0.42	10.8
Payment Related Problems From Owner Side	11	9	8	11	4	4	329	3.87	0.42	10.8
Road Length	11	5	5	10	7	6	323	3.8	0.41	10.8
Project Size / Phases	11	14	8	7	3	2	298	3.51	0.38	10.8
Financial Status Of Contractor	9	7	14	7	3	3	298	3.51	0.38	10.8
Road Width	8	8	8	12	3	3	297	3.49	0.38	10.8
Involvement Of More No. Of Parties (Contractor) In Single Project	7	9	16	5	1	1	260	3.06	0.33	10.8
Conflict Among Project Participants	8	14	7	2	1	4	238	2.8	0.3	10.8
Poor Communication Between Construction Parties	7	6	8	4	3	5	236	2.78	0.3	10.8

VII. CONCLUSION

As per the lower scale analysis in table no. III “conflict among project participants” has highest mean of 1.4. So this is the most cost influencing parameter as per lower scale analysis. But lower scale analysis represents the factors which has least influence on cost.

As per the higher scale analysis table no. IV “Traffic Intensity”, ” Alignment Of Road”, ” Time” have the highest mean of 5.87, 5.26, 5.25. So these are the most cost influencing parameters as per higher scale analysis. Also these factors have a greater influence on cost.

As values of C.V. and S.D. obtained in both the analysis are nearly equal hence above results are based on the mean of data calculated in the table I and II.

Also the accuracy of the questionnaire survey depends on the number of questionnaire i.e. more the number of questionnaires more is the accuracy of the results.

REFERENCES

- [1] Abdullah Alhomidan (2013) “ Factors Affecting Cost Overrun in Road Construction Projects in Saudi Arabia”, *International Journal of Civil & Environmental Engineering IJCEE-IJENS* Vol:13 No:03. (22.08.2014)
- [2] Bent Flyvbjerg, mette K. Skamris Holm and Soren L. Buhl, (2004) “What Causes Cost Overrun in Transport Infrastructure Project “ *Transport Reviews*, Vol. 24, No. 1, pp- 3-18. (03.09.2014)

- [3] Mahamid (2013) ‘Common risks affecting time overrun in road construction projects in Palestine: Contractors’ perspective’, *Australasian Journal of Construction Economics and Building*, Vol.13 No.2, pp. 45-53. (15.09.2014)
- [4] Shri. B.S.Patil, Dr. P.B.Ullagaddi, Dr. D.G.Jugati (2011), “factors affecting the cost and quality of construction” *International Referred Research Journal*, ISSN-0975-3486,RNI: RAJBIL 2009/30097,VOL-2 ISSUE 20. (20.09.2014)
- [5] http://en.wikipedia.org/wiki/Indian_road_network (01/01/2014).

AUTHORS

First Author – Guruprasad Chavan, M.E. (Construction & Management), Asst. Prof. KIT’S College of Engineering, guruprasadchavan2011@gmail.com.

Second Author – Amit Sharma, KIT’S College of Engineering, amd4pro@gmail.com.

Third Author – Ajay Kumar Nirala, KIT’S College of Engineering, ajaycivi@gmail.com.

Correspondence Author – Guruprasad Chavan, KIT’S College of Engineering, guruprasadchavan2011@gmail.com.

An analysis of profitability position of private bank in India

Amit Kumar Singh

Shri Atal Bihari Vajpayee Govt. Arts and Commerce College (Indore)

Abstract

Profit is a measure of success of business and the means of its survival and growth. Profitability is the ability of a business to earn profit for its owners. The objective of this study was overall profitability analysis of different private sector banks in India based on the performance of profitability ratio like interest spread, net profit margin, return on long term funds, return on net worth, return on assets & adjusted cash margin. Profitability is a measure of efficiency and control it indicates the efficiency or effectiveness with which the operations of the business are carried on. Profitability ratios provide different useful insights into the financial health and performance of a company. A business that is not profitable cannot survive. Conversely, a business that is highly profitable has the ability to reward its owners with a large return on their investment. Increasing profitability is one of the most important tasks of the business managers. Managers constantly look for ways to change the business to improve profitability. These potential changes can be analyzed with a support of income statement and balance sheet.

Keywords: Axis ICICI KVB & Yes banks Profitability, Interest spread, Net profit, long term loan, Net worth, Asset, Cash margin.

I. INTRODUCTION

Banking business in India is largely governed by the banking regulation act 1949 section 5(b) "a bank is a financial institution and a financial intermediary that accepts deposits and channels those deposits into lending activities either directly by loaning or indirectly through capital markets. A bank links together customers that have capital deficits and customer with capital surplus." Without a sound and effective banking system in India it cannot have healthy economy. The banking system in India should not only be hassle free but it should be able to meet new challenges posed by technology and any other external and internal factors. Banking plays a significant role in financing the economic needs of the country. To compete effectively in present day competitive world banks have been permitted to undertake new activities such as investment banking securities trading insurance business etc. Private banking is all about personal service and relationship built around you. It is about delivering sophisticated solutions to complex financial problems seeing your affairs in totality and offering individual advice and tailored solutions. "One claiming to be a banker must profess himself to be one and the public must accept him as such his main business

must be that of banking from which generally he should be able to earn his living."

Now short introduction of selected private banks for research

AXIS Bank

Axis Bank Limited (formerly UTI bank) is the third largest private bank in India. It offers financial services to customer segment covering large and Mid-Sized corporate MSME Agriculture and Retail businesses. Axis Bank has its headquarter in Mumbai Maharashtra.

Operation

Indian Business: As on 31 march 2014 the bank had a network of 2402 branches and extension counters and 12922 ATMS. Axis Bank has the largest ATM network among private banks in India and it operates an ATM at one of the world's largest sites at Thegu Sikkim.

International Business: The Bank has seven international offices with branches at Singapore Hong Kong (at the DIFC) Shanghai and Colombo and representative offices at Dubai And Abu Dhabi which focus on corporate lending trade finance syndication investment banking and liability businesses. In

addition to above the bank has a presence in UK with its wholly owned subsidiary Axis Bank UK Limited.

Axis Bank operates in four segments: Treasury Operation, Retail banking, Corporate/Wholesale banking and other banking business.

ICICI Bank

ICICI bank is an Indian Multinational banking and financial services company headquartered in Mumbai Maharashtra India. As on 2014 it is the second largest bank in India in term of assets and market capitalization. It offers a wide range of banking products and financial services for corporate and retail customer through a variety of delivery channels and specialized subsidiaries in the areas of investment banking life, non- life insurance, venture capital and assets management. The Bank has a network of 3880 branches and 12269 ATMs in India and has a presence in 19 countries.

ICICI Bank in one of the big four bank of India along with SBI, PNB and Bank Of Baroda. The bank has subsidiaries in the United Kingdom Russia and Canada branches in United States Singapore Bahrain Hong Kong Sri Lanka Qatar and Dubai international Finance center and representative offices in United Arab Emirates China South Africa Bangladesh Thailand Malaysia and Indonesia. The Company's UK subsidiary has also established branches in Belgium and Germany.

Karur Vysya Bank

Karur Vyaya Bank is a private sector Indian bank headquartered in Karur in Tamil Nadu. It was set up in 1916 by M.A. Venkataram Chestier and Athi Krishna Chettiar. The bank also offers internet banking and mobile banking facilities to its customers. KVB offers good services to their customers. It has 613 branches and network of 1645 ATMs as on Jan 2015. KVB total business till December 2014 was around 81000 cores. KVB is legally authorized open accounts under the new pension scheme. KVB tie up with SBI cards for a co- branded credit card. The bank is a depository participant through NSDL and open dement accounts ASBA facility available.

Yes Bank

Yes Bank is India's fourth largest private sector bank founded by Rana Kapoor in 2004 Yes bank in the only Greenfield bank license awarded by the RBI in the last two decades. Yes bank is a "Full Service Commercial Bank" has steadily built a corporate retail and SME Banking Franchise Financial Markets Investment Banking Business and transaction Banking and Wealth Management business lines across the country. As on 31 Dec 2014 the bank had 600 branches and 2000 ATMs. It had a balance sheet size of INR 1232 billion and Gross NPA of 0.42% fourth largest bank in private sector. Yes bank's corporate finance practice offers a combination of advisory services and customized products to optimized risk based on "knowledge Arbitrage". The Financial Market business model provides Risk Management solution related to foreign currency and interest rate exposures of clients.

Impact of Private Sector Bank

Today they have a market share of 20% in deposits and advances. This has been achieved in a growing market indicating

that private bank have successfully capitalized on the growth of the Indian economy. But more than acquiring market share the real contribution of private sector banks has been to transform the way banking is done in India. The new banks developed the concepts of directs selling agents who reached out to customers with credit products taking loans to the customer's doorstep. Not only did the private sector bank expand in this manner their example forced public sector banks to also adopt similar strategies. It was banks like ours which made sure that housing loan and other kinds of loans were made available in hundreds of cities and town in India.

II. OBJECTIVE OF THE STUDY

1. To analysis the profitability position of some selected private sector banks like AXIS ICICI Karur vysya bank (KVB) Yes Bank.

2. To highlight the overall profitability of bank (i.e.) Interest spread, Net profit margin, Return on long term fund, Return on net worth & Return on assets, Adjusted cash margin.

REVIEW OF LITERATURE

The researcher and economists have recognized that the measurement of profitability in banking is necessary to improve the financial soundness of banks. A large number of studies have been conducted in the field of operation and financial performance of banks. A brief review of some of these studies has been presented.

Chandan and Rajput(2002) evaluated the performance of banks on the basis of profitability analysis. The researchers analyzed the factors determining the profitability of banks in India with the help of multiple regression technique. They found that spread i.e. net interest income is the major source of income for banks. The study found public sector banks at weaker position in relation to foreign banks and public sector banks. The authors suggested that public sector banks should concentrate on non-performing asset management and also make investment in technology up gradation for better data management and quicker flow of information.

Sangmi, M. (2002) analyzed the profitability of ten selected commercial banks in India. Five best performing banks were taken in class-1 and five poor performing banks were taken in class-2 categories. The study revealed that operating cost was higher in the case of class-2 banks and in these banks the profitability was affected due to low level of spread. These banks required more scientific attempts for the investment of funds. The researcher suggested that the position of operating cost can be improve with the introduction of high level technology as well as by improving the per employee productivity.

Kumari(2003) the researcher found that in terms of deposit mobilization branch expansion credit deployment and employment generation both public and private sector banks have shown increasing trend. Banks wise analysis revealed that private sector banks have shown higher growth as compared to public sector banks. The researcher suggested that public sector banks should their profitability and productivity performance by adopting innovation modern technological changes and by fixing responsibility of officers for recovery etc.

Qamar(2003) Banks for the study purpose were categorized into public sector banks, old private banks, new private banks, and foreign sector banks. The study indicated that all the selected scheduled commercial banks were found to be different in terms of total assets, share capital, capitalization ratio and efficiency factors. Much difference in the profitability performance of banks was found due to human resources efficiency as measured in terms of business per employee.

Shannugam and Das (2004) for analyzing the efficiency of banks four outputs i.e. interest margin, Non interest income Investment and credit and four inputs i.e. deposits borrowings labour and Fixed assets have been used. The results revealed that there has been dominance of deposits in producing all the outputs the study period and an improvement I banking industry has been found in raising non-interest income investment and credits. The study indicated that state bank group and private owned foreign group performed better than their counterparts.

Arora and Verma (2005) performance of public sector banks has been evaluated on the basis of financial parameters, Operational parameters, Profitability parameters and Productivity parameters. The authors concluded that in order to remove subjectivity in banking sector major steps like prudential norms income recognition provisioning should have been taken. The researcher suggested that to correct the impact of directed investments on profitability reserve requirements should be reduced.

Reddy and Rao (2005) made an attempt to identify factors in context of financial sector reforms which could lead to changes the position of different bank groups i.e. public sector banks private sector banks and foreign sector banks in term of their overall banking industry. The authors found that the share of public sector banks has declined in total assets of banking sector due to new competitive environment. The researcher further suggested the adoption of customer oriented banking practices with new technologies for public sector banks to face stiff competition.

Arora and Kaur (2006) Financial performance of banks was analyzed on the basis of Return on assets Capital assets risk weighted, Non- performing assets to Net advances, Business per employee, Net profitability ratio, Non performing assets level and off balance sheet Operation. The researcher recommended that for enhancing financial viability of public sector banks efforts should be made to reduce the non-performing assets and upgrade the technology. For enhancing business per employee continuous and compulsory training and development programmers should be introduced in the banks.

Shukla (2009) the study analyzed that in the post reform period Indian banking system has become more competitive more developed and financially viable due to several structural changes. The study evidenced that banks should focus on high operating cost and diversification of activities to remain competitive and profitable. The study evidence that use of technology based services to intensify competition and to reduce operating cost and achieve higher profitability. The researcher recommended that some critical factors like security and integrity of system should be addressed and greater emphasis should be given on banking and financial policies to strengthen the banking sector.

Uppal (2010) study concluded that among all e channels, ATM is the most effective while mobile banking does not hold a strong position in public sector banks and old private sector banks. In new private sector banks and foreign banks mobile banking service. Mobile banking customers are also the highest in banks providing electronic services which have positive impact on net profit and business per employee of these banks. Among all foreign banks are on the top position followed by new private sector banks in providing mobile banking services and their efficiency is also much higher as compared to other groups. The study also suggested some strategies to improve mobile banking services.

Prasad and Ravinder (2011) analyzed the profitability of four major banks in India i.e. SBI, PNB, ICICI bank and HDFC bank for the period 2005-06 to 2009-2010. Statistical tools like arithmetic mean, one way ANOVA Tukey HSD test have been employed for the purpose of study. The profitability of these banks have been evaluated by using various parameters like operating profit margin gross Profit margin Net profit margin Earning per share Return on Equity Return on assets Prices earnings Ratio and Dividend payout Ratio. The study revealed that SBI performed better in terms of earning per share and dividend payout ratio while PNB performed in terms of operating profit margin and return on equity. The study found that HDFC bank outperformed in terms of gross profit margin, net profit margin, return on assets and price earnings ratio. The study evidenced that ICICI Bank paid highest portion of earning as dividends to shareholders. Analysis ranked HDFC Bank on the top position followed by PNB SBI and ICICI Bank.

III. SCOPE OF STUDY

The study shows the role of profitability position of private sector banks in India. This is the process of comparing income to output and determining how much profit was made during a specific time period. A properly conducted profitability analysis provides invaluable evidence concerning the earnings potential of a company and the effectiveness of management.

PERIOD OF STUDY

The study covers a period of 5 years from 2010-11 to 2014-15 is taken for the study.

METHODOLOGY

Sources of Data

The study is based on secondary data. Information required for the study has been collected from the annual report of AXIS, ICICI, KVB and YES bank and different books, journal, magazines, and data collected from various banks websites.

Tools Applied

In this study various statistical tools are used (i.e.) Mean and ANOVA test have been used for data analysis.

$$\text{MEAN} = \text{sum of variable}/N$$

$$\text{Standard deviation} = \sqrt{\sum X^2/N - (\sum X/N)^2}$$

$$\text{Coefficient of Variation} = \text{SD}/\text{MEAN} * 100$$

Hypothesis

An ANOVA is statistical hypothesis in which the sampling distribution of test statistic when null hypotheses is true. Null hypotheses have been set and adopted for the analysis of data.

The null hypotheses are represented by H0. It is a negative statement which avoids personal bias of investigator during data collection as well as the time of drawing conclusion.

ANOVA (ONE WAY)

Sources Of Variance	Sum Of Square	Degree Of Freedom	Mean Square	F-Ratio
Between Sample	SSC	C-1	MSC=SSC/C-1	F= MSC/MSE Or MSE/MSC
Within Sample	SSE	N-C	MSE=SSE/N-C	
Total	SST			

IV. LIMITATION OF THE STUDY

1. The study is related to a period of 5 years.
2. As the data are only secondary i.e. they are collected from the published annual reports.
3. Only profitability ratio is taken for the study.

V. A BRIEF ACCOUNT OF PROFITABILITY

The primary objective of each business enterprise is to earn profit. In facts profit earning is considered essential not only for the survival of business but is also required for its expansion and diversification. One of the most frequently used tools of financial ratio analysis is profitability ratios which are used to determine the company's bottom line and its return to its invertors. Profitability ratios are typically based on net earnings, but variations will occasionally use cash flow or operating earnings. Profitability is a measure of efficiency and control. Profitability is the main base for liquidity as well as solvency. Creditor's

banks and financial institutions are interested in profitability ratios since they indicate liquidity or capacity of the business to meet interest obligation and regular and improved profit to enhance the long term solvency position of the business. The following profitability ratio is:-

Interest Spread:-

Interest Spread refers to the difference in borrowing and lending rates of financial institutions (such as banks) in normal terms. It is considered analogous to the gross margin of non-financial companies. This is the excess of the total interest earned over total interest expended. The ratio of the interest spread to AWF shows the efficiency of bank in managing and matching interest expenditure and interest income effectively. Interest spread is critical to a bank's success as it exerts a strong influence on its bottom line.

Interest Spread%= Total interest income minus total interest expanses/ Average working fund

TABLE (1): - MEAN STANDARD DEVIATION AND COEFFICIENT OF VARIATION

YEAR	AXIX BANK	ICICI BANK	KVB BANK	YES BANK
2010-11	3.95	5.66	4.81	3.21
2011-12	6.66	6.95	4.3	3.6
2012-13	7.46	7.45	4.37	4.53
2013-14	7.9	7.82	7.16	10.73
2014-15	7.67	7.35	6.91	10.34
MEAN	6.728	7.046	5.51	6.482
SD	1.62162573	0.83440398	1.4085631	3.33921787
CV	24.1026416	11.8422364	25.5637586	51.5152402

The above analysis of bank wise mean standard deviation and coefficient of variation of interest spread of selected banks. ICICI bank has the highest mean value & KVB has lowest mean value as compare to other banks. Standard deviation of total interest income & expenses to average working fund of Yes bank

has 3.34 with highest coefficient of variation of 51.52% and ICICI bank has 0.83 low standard deviation with low coefficient variation of 11.84%.

Hypothesis:

H0: $\mu_1=\mu_2=\mu_3=\mu_4$ (There is no significant relationship between interest spread among different private sector banks in India.)

H1: $\mu_1\neq\mu_2\neq\mu_3\neq\mu_4$ (There is significant relationship between interests spread among different private sector banks in India.)

TABLE (2): Projects the result of ANOVA (one way) test

ANOVAs: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
AXIS BANK	5	33.64	6.728	2.62967
ICICI BANK	5	35.23	7.046	0.69623
KVB BANK	5	27.55	5.51	1.98405
YES BANK	5	32.41	6.482	13.93797

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	6.584175	3	2.194725	0.456096	0.716675	3.238872
Within Groups	76.99168	16	4.81198			
Total	83.57586	19				

Above analysis calculated value of ANOVA one way test (0.456096) is less than the table value (3.238872) as shown in the above table, null hypothesis is accepted. Therefore it is concluded that there is no significant relationship between the interest spread of (AXIS, ICICI.KVB & YES) private sector banks in India.

Net profit margin is the percentage of revenue remaining after all operating, interest, taxes, and preferred stock dividends (but not common stock dividends) have been deducted from a company's total revenue. The net profit margin is a number which indicates the efficiency of a company at its cost control. A higher net profit shows more efficiency of the company at converting its revenue in to actual profit.

NET PROFIT MARGIN:

$$\text{Net profit margin\%} = \text{Net profit/Revenue}$$

TABLE (3): - MEAN STANDARD DEVIATION AND COEFFICIENT OF VARIATION

YEAR	AXIS BANK	ICICI BANK	KVB BANK	YES BANK
2010-11	16.1	12.17	16.82	16.3
2011-12	18.58	15.79	16.87	15.56
2012-13	16.72	15.75	14.01	13.66
2013-14	16.39	17.19	11.72	13.61
2014-15	17.29	17.96	7.56	13.82
MEAN	17.016	15.772	13.396	14.59
SD	0.97976017	2.22335782	3.90631924	1.12099955
CV	5.75787597	14.0968667	29.1603407	7.6833417

As per table it has found that bank wise mean standard deviation & coefficient of variation of net profit margin of selected banks. Axis & ICICI bank has highest mean & KVB bank has lowest mean value i.e. 17.016, 15.772 & 13.396 as compared to other bank. Standard deviation of net profit to revenue of KVB has 3.91 with highest coefficient of variation of

29.16% and Axis bank has 0.9797 low standard deviation with low coefficient variation of 5.7578% as compared to other banks.

Hypothesis:

H0: $\mu_1=\mu_2=\mu_3=\mu_4$ (There is no significant relationship between net profit margin among different private sector banks in India.)

H1: $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4$ (There is significant relationship in India.)
 between net profit margin among different private sector banks

TABLE (4): Projects the result of ANOVA (one way) test

ANOVAs: Single
 Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Axis Bank	5	85.08	17.016	0.95993
ICICI Bank	5	78.86	15.772	4.94332
KVB	5	66.98	13.396	15.25933
Yes Bank	5	72.95	14.59	1.5708

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	36.25694	3	12.08565	2.126502	0.136986	3.238872
Within Groups	90.93352	16	5.683345			
Total	127.1905	19				

As per the table (4) it is found that calculated of ANOVA one way test (2.126502) is less than the table value (3.238872) so null hypothesis is accepted. Therefore it concluded that there is no significant relationship between net profit margin among different private sector bank in India.

RETURN ON LONG TERM LOAN:

Long term loan or debts for a company would include any financing or leasing obligation that are to come due to in a greater than 12-month period. Such obligations would include company bond issues or long term leases that have been capitalized on a firm's balance sheet. This ratio shows the relationship between net profit and the long term funds. The long term funds refer total investment in the business of long run.

Return on long term fund% = net profit/long term fund

TABLE (5): - MEAN STANDARD DEVIATION AND COEFFICIENT OF VARIATION

YEAR	AXIX BANK	ICICI BANK	KVB BANK	YES BANK
2010-11	66.34	44.72	99.9	74.73
2011-12	72.25	43.05	95.12	102.46
2012-13	88.84	52.33	110.47	131.35
2013-14	75.72	56.37	123.47	137.76
2014-15	73.36	56.48	127.09	134.67
MEAN	75.302	50.59	111.21	116.194
SD	8.31949037	6.37253089	14.051991	24.2653882
CV	11.0481665	12.596424	12.6355462	20.8835122

Table (5) shows the detail about bank wise mean, standard deviation & coefficient of variation of return on long term fund of selected banks. Yes bank & KVB have highest mean value & ICICI bank has lowest mean value when compare to rest of selected banks. Standard deviation of return on long term fund of

Yes bank has 24.265 with coefficient of variation of 20.88% and ICICI bank has 6.372 low standard deviation & high coefficient of variation is 12.596% and compare to Axis bank is low coefficient of variation of 11.048%.

Hypothesis:

H0: $\mu_1=\mu_2=\mu_3=\mu_4$ (There is no significant relationship between return on long term fund among different private sector banks in India.)

H1: $\mu_1\neq\mu_2\neq\mu_3\neq\mu_4$ (There is significant relationship between return on long term fund among different private sector banks in India.)

TABLE (6): Projects the result of ANOVA (one way) test

ANOVAs: Single
 Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Axis bank	5	376.51	75.302	69.21392
ICICI Bank	5	252.95	50.59	40.60915
KVB	5	556.05	111.21	197.4584
Yes Bank	5	580.97	116.194	736.0113

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	14469.67	3	4823.222	18.4923	1.88E-05	3.238872
Within Groups	4173.171	16	260.8232			
Total	18642.84	19				

As per the table (6) it is found that calculated of ANOVA one way test (18.4923) is greater than the table value (3.238872) so null hypothesis is rejected. Therefore it concluded that there is significant relationship between return on long term loan among different private sector bank in India.

return they are receiving from their capital investment in a company. This ratio measures the profitability of the capital invested in the business by the shareholders. Company can increase their return on equity percentage by buying back their stock increasing earning or using more debts to fund operations.

RETURN TO NET WORTH:

The return on equity ratio which is also known as the return on net worth is used by investors to determine the amount of

Return on net worth%= Net profit after tax/Equity shareholder fund

TABLE (7): - MEAN STANDARD DEVIATION AND COEFFICIENT OF VARIATION

YEAR	AXIX BANK	ICICI BANK	KVB BANK	YES BANK
2010-11	15.67	7.79	20.74	15.46
2011-12	17.83	9.35	19.65	19.16
2012-13	18.59	10.7	18.52	20.89
2013-14	15.64	12.48	17.83	22.39
2014-15	16.26	13.4	12.91	22.71
MEAN	16.798	10.744	17.93	20.122
SD	1.33969026	2.27702218	3.01715926	2.64919157
CV	7.97529624	21.1934305	16.8274359	13.1656474

Table (7) shows the detail about bank wise mean, standard deviation & coefficient of variation of return on long term fund of selected banks. Yes bank & KVB have highest mean value & ICICI bank has lowest mean value when compare to rest of selected banks. Standard deviation of return on net worth of

ICICI bank has 2.277 with coefficient of variation of 21.193% but KVB has highest standard deviation 3.017 with low coefficient of variation 16.827% with compare to ICICI bank.

Hypothesis:

H0: $\mu_1=\mu_2=\mu_3=\mu_4$ (There is no significant relationship between return on net worth among different private sector banks in India.)

H1: $\mu_1\neq\mu_2\neq\mu_3\neq\mu_4$ (There is significant relationship between return on net worth among different private sector banks in India.)

TABLE (8): Projects the result of ANOVA (one way) test

ANOVAs: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Axis Bank	5	83.99	16.798	1.79477
ICICI Bank	5	53.72	10.744	5.18483
KVB	5	89.65	17.93	9.10325
Yes Bank	5	100.61	20.122	8.77277

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	241.7146	3	80.57153	12.96633	0.00015	3.238872
Within Groups	99.42248	16	6.213905			
Total	341.1371	19				

As per the table (8) it is found that calculated of ANOVA one way test (12.96633) is greater than the table value (3.238872) so null hypothesis is rejected. Therefore it concluded that there is significant relationship between return on net worth among different private sector bank in India.

Return on assets is a financial ratio that shows the percentage of profit that a company earns in relation to its overall resources (total assets). Profitability can be measured in terms of relationship between net profit and total assets. The return on assets ratio is also known as return on investment relates to the firm's assets base and what kind of return they are getting on their investment in their assets. A high ROA indicates that management is effectively utilizing the company's assets to generate profit.

RETURN ON ASSETS:

Return on Assets%= Net profit/Total assets

TABLE (9): - MEAN STANDARD DEVIATION AND COEFFICIENT OF VARIATION

YEAR	AXIS BANK	ICICI BANK	KVB BANK	YES BANK
2010-11	395.99	463.01	297.6	90.96
2011-12	462.77	478.31	198.23	109.29
2012-13	551.91	524.01	252.68	132.49
2013-14	707.5	578.21	287.85	161.94
2014-15	813.47	633.92	310.35	197.48
MEAN	586.328	535.492	269.342	138.432
SD	172.449901	71.0073174	45.1587629	37.8878521
CV	29.4118482	13.2602013	16.7663279	27.3692875

The above table (9) which depicts that bank wise means, standard deviation & coefficient of variation of return on assets of selected banks. Axis Bank and ICICI Bank have highest mean value & Yes Bank has low mean value when compare to other private sector bank in India. Standard deviation of net profit to total assets of Axis Bank has 172.449 with coefficient variation

of 29.411% and Yes Bank has 37.887 low standard deviation with low coefficient variation of 27.369% when compared to other banks.

Hypothesis:

H0: $\mu_1=\mu_2=\mu_3=\mu_4$ (There is no significant relationship between return on assets among different private sector banks in India.)

H1: $\mu_1\neq\mu_2\neq\mu_3\neq\mu_4$ (There is significant relationship between return on assets among different private sector banks in India.)

TABLE (10): Projects the result of ANOVA (one way) test

ANOVAs: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Axis Bank	5	3517.968	586.328	23791.17
ICICI Bank	5	3212.952	535.492	4033.631
KVB	5	1616.052	269.342	1631.451
Yes Bank	5	830.592	138.432	1435.489

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	823957.7	3	274652.6	35.56323	3.29E-08	3.098391
Within Groups	154458.7	20	7722.937			
Total	978416.4	23				

As per the table (10) it is found that calculated of ANOVA one way test (35.56323) is greater than the table value (3.238872) so null hypothesis is rejected. Therefore it concluded that there is significant relationship between return on assets among different private sector bank in India.

well a company’s daily operation can transform sales of their products and services into cash. A key profitability ratio relating cash flow from operation to net sales provides powerful view into the inner working of a company using two crucial measures of company performance. The cash flow margin ratio measures the ability of a firm to translate sales in to cash.

ADJUSTED CASH MARGIN:

Adjusted cash margin also known as operating cash flow margin and margin ratio, the cash flow margin measures how

Adjusted cash margin: cash flow from operation/net sales

TABLE (11): - MEAN STANDARD DEVIATION AND COEFFICIENT OF VARIATION

YEAR	AXIS BANK	ICICI BANK	KVB BANK	YES BANK
2010-11	17.63	13.64	17.93	17.35
2011-12	18.58	17.27	18.07	16.31
2012-13	16.72	15.85	15.08	14.25
2013-14	16.39	18.2	12.92	14.15
2014-15	17.29	19.02	8.87	14.36
MEAN	17.322	16.796	14.574	15.284
SD	0.85285989	2.12116242	3.84096733	1.30613322
CV	4.9235648	12.6289737	26.3549288	8.5457552

As per table (11) it has been observed that bank wise mean standard deviation & coefficient of variation of adjusted cash margin of selected private bank in India. Axis bank has highest

mean value & KVB has low mean value when compared to other selected banks. Standard deviation of cash flow operation to net sales KVB has 3.8409 with coefficient of variation of 26.354%

and Axis bank has 0.8528 low standard deviation with low coefficient of variation of 4.9235% when compared to other private sector bank in India.

H0: $\mu_1=\mu_2=\mu_3=\mu_4$ (There is no significant relationship between adjusted cash margin among different private sector banks in India.)

H1: $\mu_1\neq\mu_2\neq\mu_3\neq\mu_4$ (There is significant relationship between adjusted cash margin among different private sector banks in India.)

TABLE (12): Projects the result of ANOVA (one way) test

ANOVAs: Single
 Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Axis Bank	6	103.932	17.322	0.581896
ICICI Bank	6	100.776	16.796	3.599464
KVB	6	87.444	14.574	11.80242
Yes Bank	6	91.704	15.284	1.705984

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	29.56373	3	9.854576	2.228311	0.116318	3.098391
Within Groups	88.44884	20	4.422442			
Total	118.0126	23				

As per the table (12) it is found that calculated of ANOVA one way test (2.228311) is less than the table value (3.238872) so null hypothesis is accepted. Therefore it concluded that there is no significant relationship between adjusted cash margin different private sector bank in India.

bank has low percentage of 7.79 at the end of March 2011. To conclude that the hypothesis there is significant relationship between return on net worth of (Axis, ICICI, KVB & Yes) private sector banks in India.

- Return on assets shows the clear picture of Axis bank has highest percentage of 813.47 at the end of March 2015 and Yes bank has very low percentage of 90.96 at the end of March 2011. To conclude that the hypothesis there is significant relationship between return on assets of (Axis, ICICI, KVB & Yes) private sector banks in India.
- Adjusted cash margin shows the detail of all private sector banks ICICI has 19.02 percentages at the end of March 2015 and KVB has 12.92 percentages at the end of March 2014. . To conclude that the hypothesis there is no significant relationship between adjusted cash margin of (Axis, ICICI, KVB & Yes) private sector banks in India.

VI. FINDING

- Interest spread shows that Yes bank has 10.72 percentages at the end of March 2014 and also Yes bank has low percentage of 3.21 at the end of March 2011. To conclude that the hypothesis there is no significant relationship between interest spread of (Axis, ICICI, KVB & Yes) private sector banks in India.
- Net profit margin reveals that Axis bank has highest percentage of 18.58 at the end of March 2012 and KVB has low percentage of 7.56 at the end of March 2015. To conclude that the hypothesis there is no significant relationship between net profit margin of (Axis, ICICI, KVB & Yes) private sector banks in India.
- Return on long term fund of selected banks for research the overall percentage of Yes bank has 137.76 at the end of March 2014 and ICICI bank has low percentage of 43.05 at the March 2012. To conclude that the hypothesis there is significant relationship between return on long term fund of (Axis, ICICI, KVB & Yes) private sector banks in India.
- Return on net worth shows that Yes bank has highest percentage of 22.71 at the end of March 2015 and ICICI

VII. CONCLUSION

Private bank in India has got a great response in terms of service and quality banking. Globalization has encouraged multinationals and foreign banks to set up their business unit in a developing country like India. Private sector banks should increase their profitability and productivity performance by adopting innovation modern technological changes and by fixing responsibility of officers for recovery etc & operating cost can be improve with the introduction of high level technology as well

as by improving the per employee productivity. The study indicated that all the selected private sector banks were found to be different in terms of total assets, interest spread, and net worth ratio and efficiency factors & there is also difference among the mean value of interest spread, net profit margin, return on long term fund, return on net worth & adjusted cash margin and there is no difference among the mean value of return on asset of private banks. So profitability ratios are employed by the management in order to assess how efficiently they carry on their business operations and also it is suggested for the entire bank to take effective steps to improve the operating efficiency of the business. Much difference in the profitability performance of banks was found due to human resources efficiency as measured in terms of business per employee. Profitability of private sector banks in India plays major role in banking sector without profit the investors cannot run the business. Profitability measure a company's ability to generate earnings related to sales, assets and equity. These ratios assess the ability of a company to generate earnings, profits and cash flows relative to relative to some metric, often the amount of money investment. Profitability ratios provide a definitive evaluation of the overall effectiveness of management based on the returns generated on sales and investment. Profitability is the primary motivating force for any economic activity. Business enterprise is essentially being an economic organization; it has to maximize the welfare or the investment of its stakeholders. To this end, the business undertaking has to earn profit from operations. Profitability acts as a yardstick to measure the effectiveness and efficiency of business effort for the growth and success of any business entities.

REFERENCES

- [1] Kaur, A. (1991), Profits and Profitability of Indian Nationalized Banks, A Ph.D. Thesis, Submitted to Panjab University, Chandigarh.
 - [2] Kaur, A. (1993), Profits and Profitability in Commercial Banks, Deep and Deep Publication, New Delhi, 1993.
 - [3] Arora, S. and Kaur, S. (2006) "Financial Performance of Indian Banking Sector in Post-Reforms Era", The Indian Journal of Commerce, Vol.59, No.1, Jan.-March.
 - [4] Chandan, C.; and Rajput, P. K. (2002) "Profitability Analysis of Banks in India – A Multiple Regression Approach", Indian Management Studies Journal, June, pp.119-129.
 - [5] Cheema, C.S.; and Agarwal, M. (2002), "Productivity in Commercial Banks: A DEA Approach", The Business Review, Vol.8, No. 1 & 2.
 - [6] Kohli, H.; and Chawla, A.S. (2006), "Profitability Trends in Commercial Banks – A Study of Selected Commercial Banks", Indian Management Studies Journal, October, Vol.11, No.2, pp. 51-70.
 - [7] Kumari H. (2003), Productivity in Public and Private Sector Banks, A Ph.D. Thesis, Submitted to Punjabi University, Patiala.
 - [8] PRIYA S. (2014) "an analysis of profitability of private sector bank in India", MGR College, Hosur/ Periyar University, India.
 - [9] Maji, G.S.; and Day, S. (2006), "Productivity and Profitability of Select Public Sector Banks in India: An Empirical Analysis", The ICFAI Journal of Bank Management, Vol. V, No. 4, pp. 59-67.
 - [10] Prasad, K.V.N. and Ravinder, G. (2011), "Performance Evaluation of Banks: A Comparative Study on SBI, PNB, ICICI and HDFC", Advances in Management, Vol. 4(2) September, pp. 43-53.
 - [11] Singla, A.; and Arora, R.S. (2005), "Financial Performance of Public Sector Banks: A Comparative Study of Canara Bank and Indian Bank", Punjab School of Business Studies, Vol.I, No.1, April-Sep., pp. 87-93.
 - [12] Sooden, M.; and Bali, M. (2004), "Profitability in the Public Sector Banks in India in the Pre and Post-Reform Period: A Study", Indian Management Studies Journal, School of Management Studies, Punjabi University, Patiala, Vol.8, No.2, August, pp. 69-91.
 - [13] Vyas, R. (1992), "Profitability of Commercial Banks in India: A Comparative Study of Public Sector Banks, Private Sector Banks and Foreign Sector Banks Operating in India", A Ph.D. Thesis submitted to Institute of Management Studies, Devi Ahilya Vishwavidyalaya, University of Indore, M.P. Available at www.academicfoundation.com.
- Bibliography
- Books:**
- [1] C.R Kothari (2010), "Statistical methods", S Chand & Sons New Age International (P) Ltd Publishers, New Delhi.
 - [2] G.Sudarsana Reddy (2012), "Financial Management", Himalaya Publishing House Pvt Ltd, Mumbai.
 - [3] Dr.V.Radha (2012), "Banking Theory, Law & Practice", Prasanna publishers & Distributors, Chennai.
 - [4] N.P.Srinivasan & M.Sakthivel Murugan (2010), "Accounting for Management", S.Chand & Company Ltd, New Delhi.
 - [5] Dr.R.Ramachandran & Dr.R.Srinivasan (2012), "Management Accounting", Sriram Publications, Trichy.
 - [6] Prof. Nirmal Jain (2009) "Fundamentals of Financial management" Nakoda publisher & printer Indore.

Dynamics of soil organic carbon and soil texture in Marine National Park, Gujarat

Megha Bhatt*, Ekta Patel** and Y.T. Jasrai***

*Women Scientist (WOS-A, DST Project), Dept. Of Botany, Gujarat University

**Research Scholar, Department of Botany, Gujarat University

***Ex-Head, Department of Botany, Gujarat University

Abstract- The soil carbon stock can surely be taken as one of the important parameter in deciding strategies for management of different soils falling under different physiographic region of the country. In this paper, a soil database of topsoil estimates of soil organic carbon and soil organic carbon stock for Marine National Park, Gujarat is highlighted. Along with soil organic carbon stock, its correlation with the texture of the soil is also established.

Index Terms- Soil organic carbon (SOC), Carbon Sequestration (CS), top soil, global change, bulk density, Soil texture.

I. INTRODUCTION

Soil is one of the three major natural resources. Soil is made up of three main components- minerals that come from rocks below or nearby, organic matter (SOM) and the living organisms that reside in the soil. SOM is formed by the biological, chemical and physical decay of organic materials that enter the soil system from sources above ground (e.g. leaf fall, crop residues, animal wastes and remains) or below ground (e.g. roots, soil biota). The elemental composition of SOM varies, with values in the order of 50 per cent carbon (Broadbent 1953), 40 per cent oxygen and 3 per cent nitrogen, as well as smaller amounts of micronutrients. Thus, SOC is the main constituent of Soil organic matter. (Schuur et al., 2001) found that the top soil (0-20 cm) total C of the different ages of the rehabilitated forest was significantly different from those of the subsoil (20-40 cm and 40-60 cm). This was due to the positive correlation of C and SOM. This suggests that the SOM is a source of C as C is stored in the soil profiles in the form of SOM (Brady and Wel, 2002).

Carbon is usually derived from weathering of the material/geology, the decomposition of plant and animal matter, or by addition through anthropogenic activities (Schumacher B.A., 2002). The soil organic C (SOC) plays an important role in the global C cycle. It is generally assumed that soils are the largest C sinks in terrestrial ecosystems. The carbon stock of soil equals 1500 Pg in the topmost 1 m soil layer (Eswaran, et al., 1993; Jobbágy and Jackson, 2000), and approximately 506 Pg (32 percent) of this is in the tropics (Eswaran, et al., 1993) and 160 Pg in Africa (Henry, et al., 2009). Sombroek et al., (1993) were able to estimate organic carbon stocks by FAO soil group and the soil carbon stock of the world. The first available estimate for forest carbon stocks (biomass and soil) for the year 1986, were in the range of 8.58 to 09.57Gt C (Ravindranath et al., 1997, HariPriya, 2003; Chhabra and Dadhwal, 2004). The

current estimate of Indian forest phytomass C pool are in the range of 2000-4400 T g C (Lal and Singh, 2000; Chhabra et al., 2003). Globally, soil C pools contain approximately 1550 Gt of organic C in the top 1m (from a total of approximately 2500 Gt C), and SOC sequestration the annual release from fossil fuel combustion (Lal, 2004; Houghton, 2005). The rate of soil organic carbon sequestration adoption of recommended technologies depends on soil texture and structure, rainfall, temperature, farming system and soil management. Organic matter binds to minerals, particularly clay particles, and a process that further protects carbon (Von Lützow et al., 2006). Key site-specific parameters influencing soil carbon dynamics are soil texture and foliar lignin content (schimel et al., 1994,) their results showed that soil carbon is related linearly to soil texture, increasing as clay content increases, that soil carbon stores and turnover time are related to mean annual temperature by negative exponential functions, and that heterotrophic respiration originates from recent detritus (~50%), microbial turnover (~30%), and soil organic matter (~20%) with modest variations between forest and grassland ecosystems. Soil texture is simply the relative proportion of sand, silt and clay in a given soil sampling and thus is useful and important in identifying properties of soil characteristics such as water holding capacity, soil drainage and soil fertility. Feller, C., & Beare, M. H. (1997) came up with Physical control of soil organic matter dynamics in the tropics wherein they showed the role that soil physical properties (mineralogy, texture, and structure) play in regulating the accumulation and loss of SOM in tropical soils. They also showed the relationships between total SOM and soil physical properties like effects of climate and mineralogy on latitudinal gradients in SOM, interactions between texture and mineralogy as determinants of SOM storage. This will show its distribution among fractions and characterise its biochemical composition, bioavailability and turnover time.

II. MATERIAL AND METHODOLOGY

Study area : India is lined with a 7500 km long coastline. Among the Indian maritime state, Gujarat state has the longest coastline extending to 1600 km. Marine national park is second largest covering more than 33% area amongst four national parks present in State of Gujarat.

This national park is the protected area on the southern coast of the Gulf of Kachchh in the Jamnagar District of Gujarat state, India. It is Mangrove forest occupying area of 162.89 sq.km. The latitude and longitude of the park is 22.4667° N, 69.6167° E

respectively. There are 42 islands on the Jamnagar coast in the Marine National Park and the best known ones are Pirotan, Narara, Sikka and Kalubhar of which we have explored Narara and Sikka for sampling purpose.

Random sampling of soil collection is done using GPS. The GPS points are decided randomly knowing the different eco-zone in the park and are decided according to the area of National Park which should be at least 25% of the area of National Park Published by FAO-Data. The soil samples are collected from on site at 3 different depths: 0-10cm, 10-20cm, and 20-30 cm in the month of February 2012. For the estimation of Total Soil Organic Carbon from soil, wet digestion titrimetric method (Walkley and Black, 1934), was adopted. The correction factor of 1.33 was applied as mentioned in Krishnan G. 2009). For Soil Texture analysis, spread soil on a newspaper to dry. Remove all rocks, trash, roots, etc. Crush lumps and clods and then followed the methodology in (Gupta P.K., 2006).

Calculation for the experiments is as follows: The formula for estimation of Organic carbon (OC) used was as follows:

$$\% \text{ easily oxidizable OC} = \frac{(B-S) \times M \text{ of Fe}^{2+} \times 12}{100 \times 4000} \times \text{Sample gram of soil}$$

$12/4000 = 0.003$ is the miliequivalent weight of soil, B blank burette reading, S sample burette reading, M of Fe^{2+} is Molarity of $\text{Fe}^{2+} = 0.5 \text{ N}$ and Sample gm of soil taken was 0.5 gm

Obtained amount of OC is multiplied by Conversion factor of 1.32 to get the actual amount of underestimated SOC (Krishnan G., 2009).

The SOC density (SOCD) for each interval was then calculated using the following equation:

$$\text{SOCD} = \text{SOC} \times \text{BD} \times h$$

Where SOCD = Soil Organic Carbon Density (t/ha)

SOC = Soil Organic Carbon Concentration

BD = Bulk Density (gm/cm^3) and

h = soil depth for the interval (e.g. 0-10 cm, 10-20 cm and 20-30 cm)

The SOCD of 0-10 cm, 10-20 cm, and 20-30 cm were calculated and analyzed in this study. Using above values, SOC stock (SOCS) was also measured using the following formula.

$$\text{SOCS} = \text{SOCD} \times \text{AREA} / 10^{10}$$

The bulk density was estimated for every sample. Bulk Density calculations adopted from (Cress well and Hamilton, 2002). Accordingly the total amount of SOC available in the entire National Park was calculated using the mean of all the sites and the average bulk density.

$$\text{Bulk Density (p)} = \text{Bulk density (g}/\text{cm}^3) = \text{Dry soil weight (g)} / \text{Soil volume (cm}^3)$$

Soil texture was obtained by methodology as followed from Gupta P.K. (2006). Relationships between SOC concentration in the near surface layer and at depth were determined by regression

analysis. Correlation of SOC with different parameters like BD, EC and pH were also analyzed.

III. RESULTS AND DISCUSSION

The results and graph of (1.) Available Total Organic Carbon and (2.) Soil texture of Marine National Park describes about both parameters briefly. The SOC level of all the samples in this study ranged from 0.04-2.39 in percentage. The mean organic carbon was $0.47 (\pm 0.055)$ percent. The maximum mean was present in samples analyzed at the depth of 0-10 as $0.48(\pm 0.10)$ percent, followed by $0.47(\pm 0.094)$ percent. Therefore depth wise, the highest SOC 1.19% being present in layer 1 i.e., 0-10cm and lowest in 0.04% in layer 3 i.e., 20-30cm. The Narara sites showed OC values obtained in the range of 0.08-0.59 % whereas Samples from Sikka showed values varying from 0.44-1.19%. That means OC values were low in samples taken from Narara as compared to samples collected from Sikka. The following graph shows the available total organic carbon in Marine national park at Narara and Sikka site. As seen for SOC results, SOCD values obtained also showed uniformity site-wise. The SOCD values were minimum of $0.40 \text{ gm}/\text{cm}^2$ found in the samples collected from depth 10-20cm and maximum of $13.40 \text{ gm}/\text{cm}^2$ in the upper layer 0-10cm. The statistical mean obtained for all three layers $5.32(\pm 1.15)$, $5.15(\pm 1.07)$, and $4.69(\pm 1.01)$ respectively for the depth of 0-10, 10-20 and 20-30cm.

SOC shows moderately weak negative correlation with soil pH ($R = -0.623$) and EC shows moderately positive correlation with soil OC as $R = 0.608$. BD shows weak correlation with SOC. Normally it shows decreasing trend in the amount of organic carbon but few exception of site 5,6, 7 and the decreasing upper layer in high tide and low tide.

Average % of clay obtained is 1.03 followed by average % of silt as 39.2 and finally average % of sand obtained is 58.7. In Marine National Park the average % of clay is ($P = 1$) i.e. positively correlated with amount of total Organic Carbon followed by average % of silt which is ($P = -0.762$) significantly negatively correlated whereas the average % of sand is ($P = 0.751$) sparsely positively correlated with the amount of total available Organic Carbon of Marine National Park.

A pH range of approx. 6-7.5 promotes the most ready availability of plant nutrients. Highly alkaline pH values shows low decomposition rates increasing turn over times of nutrient. Though Marine National park show high amount of number of microbial species present (Bhatt et al., 2015) but, the pH in Marine National Park is alkaline in nature hence it signifies low decomposition rates as compared to Gir and Vandsa National Parks.

IV. CONCLUSION

The determination of total organic carbon is an essential part of any site characterization or ecological assessment since its presence or absence can markedly influence how chemicals will react in the soil or sediment. Sites in Narara showed little less available organic carbon as compared to sites in Sikka. Presence of Mangroves and algal blooms in Narara surely affects the kind of soil microflora present therein (Bhatt et al., 2015) and that

inturn affects the amount of Soil microbial biomass carbon (Bhatt and Banmeru, 2014) affecting decomposition rates of SOC. The overall SOCS stock was found to be 24.56 Tg of Soil organic carbon in total area of 162 square kilometers of the national park. We can surely conclude that the amount of SOC shows decreasing trend with the depth. pH in Marine National Park is alkaline in nature hence it signifies low decomposition rates. Climate affects SOC amount as it is a major determinant of the rate of decomposition and therefore the turnover time of C in soils. Soils with high clay content therefore tend to have higher SOC than soils with low clay content under similar land use and climate conditions.

ACKNOWLEDGEMENT

Authors thank Department of science and technology, Govt. of India for funding this project work. We also thank Dept. of Botany, Gujarat University to have given space and Cooperation whenever required. Our Special thanks to Gujarat forest department and Park authorities of Marine National Parks for providing assistance in different stages and for permission to carry out the study under the said DST Project.

REFERENCES

- [1] Bhatt, M. (2014). A Study on Terrestrial Nitrogen Cycle in India. Scholars' Press.
- [2] Bhatt, M., Patel, S., Prajapati, P., & Jasrai, Y. T. (2015). Isolation and Identification of Soil Microflora of National Parks of Gujarat, India. *Int. J. Curr. Microbiol. App. Sci.*, 4(3), 421-429.
- [3] Bhatt, M., & Banmeru, S. (2014). Estimates of soil microbial biomass carbon of forest soil types of Gujarat, India. *Int. J. Curr. Microbiol. App. Sci.*, 3(11), 817-825.
- [4] Brady N. C. & Weli R. R (2002). The nature and properties of soils, 13th edition. Pearson Education Inc. New Jersey, pp. 668-772.
- [5] Broadbent, F.E. (1953). The soil organic fraction. *Advances in Agronomy*, 5,153-183.
- [6] Chhabra, A., and Dadhwal, V.K (2004) Assessment of major pools and fluxes of carbon in Indian forests, *Climate Change* 64, 341-360.
- [7] Chhabra A., Palria S., Dadhwal V.K. (2003) 'Soil organic pool in Indian forests'. *Forest, Ecology and Management*, 173: 187-199.
- [8] Cress well and Hamilton, 2002
- [9] Eswaran, H., van den Berg, E. & Reich, P. (1993) Organic carbon in soils of the world. *Soil Science Society of America J.*, 57: 192-194.
- [10] Feller, C., & Beare, M. H. (1997). Physical control of soil organic matter dynamics in the tropics. *Geoderma*, 79(1), 69-116.
- [11] Gupta P. K. (2006) Soil, Plant, Water and Fertilizer analysis. Agrobios India Publishing, pp 132-135.
- [12] Haripriya G.S. (2003) Carbon budget of the Indian forest ecosystem. *Climate Change* 56, 291-319.
- [13] Henry, M., Gineste, M., Martel, S., Asante, W., Adu-Bredu, S., and Saint-Andre, L. (2009), Impact of Forest Degradation caused by Selective Logging on Carbon Stocks in a Wet Evergreen Forest of Ghana. Paper Presented at the XIII World Forestry Congress Buenos Aires, Argentina, 18 – 23 October.
- [14] Houghton, R. A.: The contemporary carbon cycle, in: *Biogeochemistry*, edited by: Schlesinger, W. H., Elsevier-Pergamon, Oxford, 473-513, 2005.
- [15] Jobbagy, E.G. & Jackson, R.B. (2000). The vertical distribution of soil organic carbon and its relation to climate and vegetation. *Ecological Applications*, 10, 423-436.
- [16] Krishnan G. , Srivastav S. K., Suresh Kumar, Saha S. K. and Dadhwal V. K. (2009) Quantifying the underestimation of soil organic carbon by the Walkley and Black technique – examples from Himalayan and Central Indian soils. *Current Science*, 96(8), 25.
- [17] Lal, R. (2004) Soil carbon sequestration to mitigate climate change, *Geoderma*, 123, 1-22,
- [18] Lal and Singh (2000). Carbon sequestration potential of Indian forests. *Environ Monit Assess* 60: 315-327.
- [19] Ravindranath, N. H. and Somashekhar B.S. and Gadgil, M. (1997) Carbon flows in Indian forests. *Climate Change* 35,297-320.
- [20] Schumacher, B.A. (2002), Methods for the determination of total Organic Carbon (TOC) in Soils and Sediments pp.2-5.
- [21] Schuur, E. A. G. O. A. Chadwick, and Matson P. A. (2001). Carbon cycling and soil carbon storage in mesic to wet Hawaiian montane forests. *Ecology* 82: 3182-3196.
- [22] Sombroek, W., Nachtergaele, F. O., and Hebel, A. (1993). Amounts, dynamics and sequestering of carbon in tropical and subtropical soils, *Ambio*, 22, 417-426.
- [23] Schimel, D. S., Braswell, B. H., Holland, E. A., McKeown, R., Ojima, D. S., Painter, T. H. & Townsend, A. R. (1994). Climatic, edaphic, and biotic controls over storage and turnover of carbon in soils. *Global biogeochemical cycles*, 8(3), 279-293.
- [24] Von Lützw, M., Kögel-Knaber, I., Ekschmitte, K., Matzner, E., Guggenberger, G., Marschner, B. and Flessa, H. (2006). Stabilization of organic matter in temperate soils: mechanisms and their relevance under different soil conditions –a review. *European Journal of Soil Science*, 57, 426-445.
- [25] Walkley, A. and Black I. A. (1934) An examination of Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Sci.* 37:29-37.

AUTHORS

First Author – Dr. Megha Bhatt (PhD.) Dept. of botany, Gujarat University, megsal1624@gmail.com.

Second Author – Ms. Ekta Patel (Msc.) Dept. of botany, Gujarat University.

Third Author – Dr. Y.T. Jasrai, Ex-Head Dept. of botany, Gujarat University.

Correspondence Author – Dr. Megha Bhatt
Email: megsal1624@gmail.com, megsal1624@yahoo.co.in
Contact: +91 9998936340.

Figure 1 Graph showing Marine National Park covering second largest area amongst National parks of Gujarat.

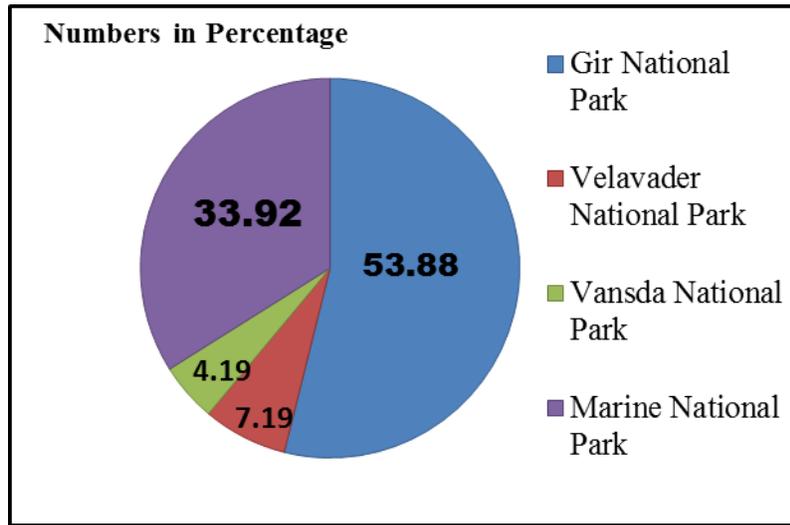


Figure 2 showing site of Marine national Park

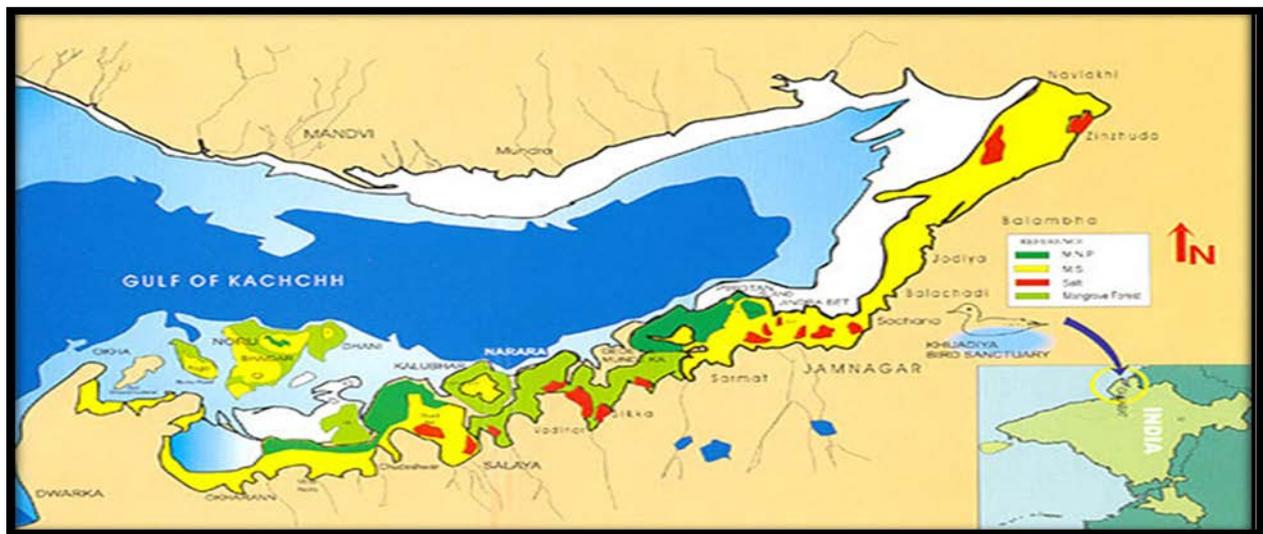


Figure 3 showing site wise available Organic carbon Percent at different Depths.

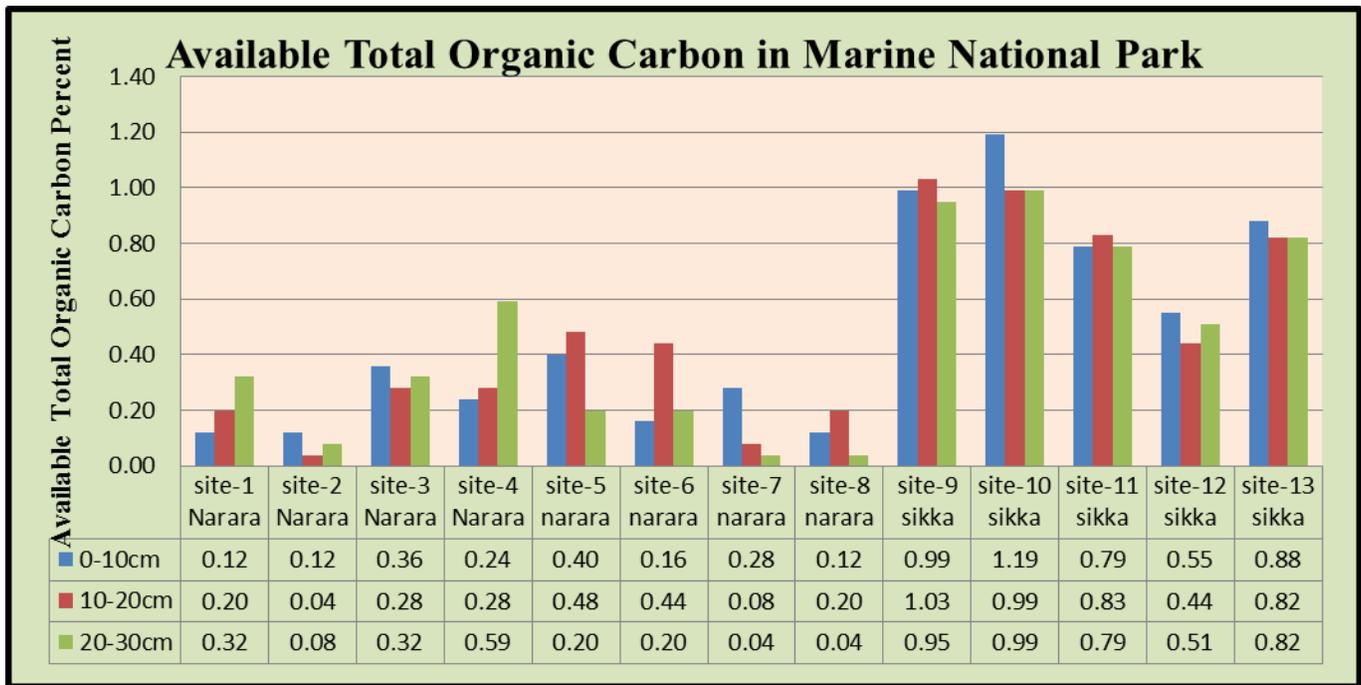
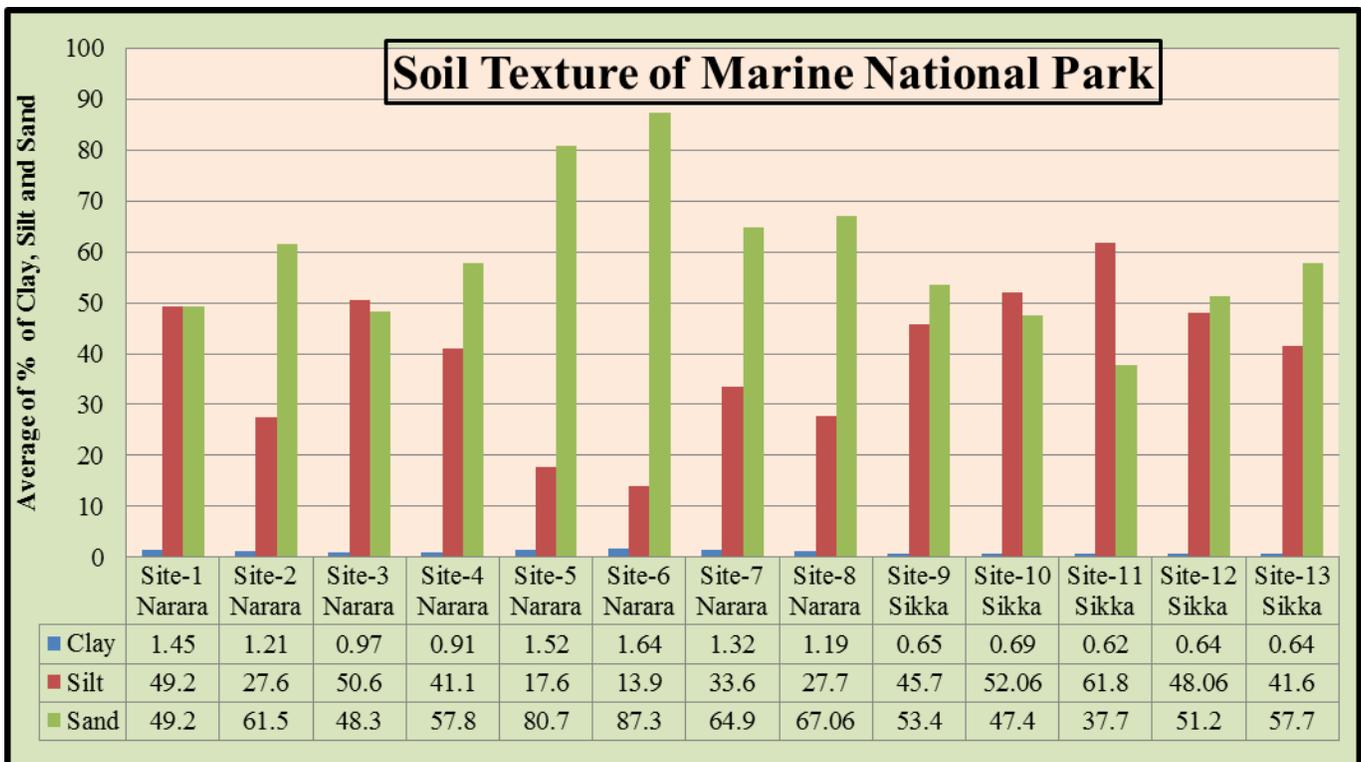


Figure 4 sitewise average Percentage of Clay, Sand and silt.



Effects of Quality Management Systems on Performance of Kenya Ports Authority

Daniel Jonai Matata* and Moses Kimani Wafula**

* Planning Technician, Kenya Ports Authority, 95013-80107 Mombasa, Kenya

** Senior Assistant Librarian, Jomo Kenyatta University of Agriculture and Technology

Abstract- A quality management system improves organization's performance through quality service delivery and production thus enabling organizations to have a competitive edge over its competitors. In order to be successful, Quality Management (QM) practices ought to be an integral part of any organization's strategic management. Without proper monitoring of projects, poor quality of material use, and lack of proper site supervision due to inconsistent supervision may lead to poor performance in an organization. Communication is a vital tool in managing any form of business as it helps the organization in achieving its objectives. Documentation is also a limitation in the organization which deals with many stakeholders. Poorly kept records results into non-conformity due to delays caused by searching work records which are not well kept.

This study aimed at determining the effects of Quality Management System (QMS) on performance of Kenya Ports Authority. A target population totaling to 7,500 personnel from whom sample size of 116 was randomly selected from the sampled departments was used to build a basis for the research. The researcher used multi-stage cluster sampling from the sample population to achieve the desired representation from various divisions within the organization. Questionnaires, interviews and observations were used to gather the required information. A descriptive analysis was done with the help of a statistical tool. It was evident that QMS has a great positive impact on the performance of an organization through service delivery and quality production, thus giving an organization a competitive edge in the market.

Index Terms- Quality Management Systems, Total Quality Management, International standardization Organization, and competitive advantage

I. INTRODUCTION

Quality management system (QMS) is a systematic approach to proactively managing quality based on documented standards and operating procedures. The best known QMSs are those based on the ISO 9000 series of quality standards. A quality management system (QMS) can be expressed as the organizational structure, procedures, processes and resources needed to implement quality management. Early systems emphasized predictable outcomes of an industrial product production line, using simple statistics and random sampling. By the 20th century, labor inputs were typically the most costly inputs in most industrialized societies, so focus shifted to team cooperation and dynamics, especially the early signaling of

problems via a continuous improvement cycle. In the 21st century, QMS has tended to converge with sustainability and transparency initiatives, as both investor and customer satisfaction and perceived quality is increasingly tied to these factors. (Cole & Kelly 2011, Juran, 2009, BSI 1991 Durai, and Balakrishnan 2011).

Quality Management System enables one to demonstrate commitment to quality and customer satisfaction, as well as continuously improving company's operations. The goal is for all organizations to seek continuous performance improvement. Quality management of the product or service includes a quality planning requirement along with policies, objectives and quantifiable targets. Quality Management System establishes and streamlines processes through complete documentation, improves and establishes training processes defines roles and responsibilities, increases operational efficiency. QMS also develops and builds relationships that help to retain existing customers; it improves customer relations; it ensures carefully planned improvements, based on documentation and analysis and provides for regular audits/reviews of performance (Chris, 2009, Chong 2006, Feigenbaum 1961, Nanda, 2005).

Kenya Port Authority also known as Mombasa Old Port by its old name is situated on the North side of Mombasa Island. The Port became famous during the spice trade between East Coast of Africa, the Indian Peninsula, the Arabian Gulf and the Far East (www.kpa.co.ke). The development of the modern Port facilities was therefore started at the Kilindini Harbour in 1896. Kenya Ports Authority (KPA) was established by an Act of Parliament (CAP 391 of the Laws of Kenya) with the mandate to maintain, operate, improve and regulate all scheduled seaports situated along Kenya's coastline. The Authority's scope on quality management system covers activities on marine services, cargo handling services and short-term warehousing in Mombasa, Nairobi and Kisumu. Other offices include Kampala-Uganda (Liaison office) and Lamu. (KPA Handbook, 2012-13).

KPA's (The Quality Manual) QMS describes methods by which it complies with the ISO 9001:2008 Quality Management System requirements. KPA's Quality Management System, as outlined in this Quality Manual combines a management structure with a defined set of processes and procedures to ensure that customers' requirements are met. The Authority has established, documented, implemented and maintained a quality management system that continually improves its effectiveness in accordance with the requirements of ISO 9001:2008 comprising of;

- a) Identification of the processes needed for Quality Management System and their applications throughout the Authority.

- b) Detailed process maps that determine the sequence and interaction of these processes
- c) Documented QMS Manuals that determine the criteria and methods needed to ensure that both the operation and control of these processes are effective.
- d) Monitoring, measuring and analyzing of these processes according to the respective functional unit's established criteria.
- e) Implementing actions necessary to achieve planned results and continually improvement of these processes by the respective functional units.

The Authority determines, collects and analyzes appropriate data to demonstrate the suitability and effectiveness of the QMS and to evaluate where continual improvement of the effectiveness of the QMS can be made (KPA Handbook, 2013-14).

II. LITERATURE REVIEW

Theories in TQMS

1. Deming's Theory

According to Bowen R (2013) Deming's theory of Total Quality Management rests upon fourteen points of management, the system of profound knowledge, and the Shewart Cycle (Plan-Do-Check-Act). Quality is equal to the result of work efforts over the total costs. If a company is to focus on costs, the problem is that costs rise while quality deteriorates. Deming's system of profound knowledge consists of the System Appreciation – an understanding of the way that the company's processes and systems work, Variation Knowledge – an understanding of the variation occurring and the causes of the variation, Knowledge Theory – the understanding of what can be known, and Psychology Knowledge – the understanding of human nature

By being aware of the different types of knowledge associated with an organization, then quality can be broached as a topic. Quality involves tweaking processes using knowledge. The fourteen points of Deming's theory of total quality management are; Create constancy of purpose, Adopt the new philosophy, Stop dependencies on mass inspections, Don't award business based upon the price, Aim for continuous production and service improvement, Bring in cutting-edge on the job training, Implement cutting-edge methods for leadership, Abolish fear from the company, Deconstruct departmental barriers, Get rid of quantity-based work goals, Get rid of quotas and standards, Support pride of craftsmanship, Ensure everyone is trained and educated and Make sure the top management structure supports the previous thirteen points (Chris, 2009, Aguayo, *et al*, 1990, Goetsch, *et al*, 2013).

2. Joseph Juran's Theory

Joseph Juran is responsible for what has become known as the "Quality Trilogy." The quality trilogy is made up of quality planning, quality improvement, and quality control. If a quality improvement project is to be successful, then all quality improvement actions must be carefully planned out and controlled. Juran believed there were ten steps to quality improvement. These steps are: An awareness of the opportunities and needs for improvement must be created, Improvement goals

must be determined, Organization is required for reaching the goals, Training needs to be provided, Initialize projects, Monitor progress, Recognize performance, Report on results and track achievement of improvements (Joseph Juran, 2009).

3. The EFQM Framework

The European Foundation for Quality Management (EFQM) Model is based upon nine criteria for quality management. There are five enablers (criteria covering the basis of what a company does) and four results (criteria covering what a company achieves). The result is a model that refrains from prescribing any one methodology, but rather recognizes the diversity in quality management methodologies. The nine criteria as defined by the EFQM Model are: Focus on Results – pleasing company stakeholders with results achieved by stakeholders is a primary focus, Focus on Customers – it is vital that a company's quality management leads to customer satisfaction, Constancy of Purpose and Consistent, Visionary Leadership, Process and Facts form the Management Focus – Management breaks down everything into systems, processes and facts for easy monitoring, Training and Involving Employees – Employees should receive professional development opportunities and be encouraged to remain involved in the company. Continuous Learning – everyone should be provided with opportunities for learning on the job, Developing Partnerships – It is important to encourage partnerships that add value to the company's improvement process. Social Responsibility of the Corporation – The company should always act in a way where it is responsible towards the environment and society at large (James and Williams, 2008, Goetsch, *et al*, 2013)

Other Related Works

1. Organizational Culture

Daft (2004), defines culture as a set of values, norms, guiding beliefs and understandings that is shared by members of an organization and is taught to new members. Everyone participates in culture, but culture generally goes unnoticed. It is only when organizations try to implement new strategies or programs that go against basic cultural norms and values that they come face to face with the power of culture (Goetsch, *et al*, 2013 Etienne-Hamilton, 1994).

According to Huczynski, A. and Buchanan, D. (2013) Goetsch, *et al*, (2013) culture is the collection of relatively uniform and enduring values, beliefs, customs, traditions and practices that are shared by an organization's members, learned by new recruits and transmitted from one generation of employees to the next. Culture provides members with a sense of organizational identity and generates in them a commitment to beliefs and values that are larger than themselves. Cultures serve two critical functions in an organization i.e. to integrate members so that they know how to relate to one another and to help the organization adapt to the external environment

2. Employee Involvement

People at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefit. Involving people and their abilities at all levels can only bring benefit to the organization. Motivating people, holding them accountable for their own performance and involving them in decision making inspires innovation and creativity. Employee involvement approaches can range from simple sharing of information or providing input on work-related

issues and making suggestions to self-directed responsibilities such as setting goals, making business decisions and solving problems, often in cross-functional teams (James and Williams,

2008, Goetsch, *et al*, 2013).. The continuum of employee involvement approaches is summarized in the table 1 below.

Table 1. Levels of employee involvement

Level	Action	Primary outcome
Information sharing	Mangers decide, then inform employees	Conformance
Dialogue	Managers get employees input, then decide	Acceptance
Special problem solving	Managers assign a one-time problem to selected employees	Contribution
Intragroup problem solving	Intact groups meet weekly to solve local problems	Commitment
Intergroup problem solving	Cross-functional groups meet to solve mutual problems	Cooperation
Focused problem solving	Intact group deepen daily involvement in a specific issue	Concentration
Limited self-direction	Teams at selected sites function full time with minimum supervision	Accountability
Total self-direction	Executives facilitate self-management in an all-team company	Ownership

Source: James and William (2008).

3. Management Commitment

Top Management in organizations maintains the leadership responsibility for the quality management systems, with involvement of all organizational staffs. This responsibility includes; ensuring the availability of resources to all staff to ensure improved service delivery is achieved for the realization of the organization’s vision and mission. Establishing and reviewing the quality policy and quality objectives quarterly to ensure compliance to the quality standards (Cane, Sheila 1996 Soltani, 2005, Ali and Abedalfattah 2012).

Leaders should provide a clear vision of the organization’s future and set challenging goals and targets. It is only through unity of purpose and direction of employees that achieves organization’s objectives. Leader should maintain internal environment where people can get fully involved by establishing trust and eliminating fear. (Cole & Phil 2011) defines leadership as the process of influencing others to understand and agree about what needs to be done and how to do it, and the process of facilitating individual and collective efforts to accomplish shared objectives.

4. Customer Focus

It is essential for an organization to understand current and future customer needs. It should strive to meet customer requirements and exceed customer expectations. This could be done by communication throughout the organization, measuring customer satisfaction and systematically managing customer relationships. Ensuring a balanced approach and acting on findings is vital. Organizations depend on their customers and therefore should understand current and future customer needs, should meet customer requirements and strive to exceed customer expectations. Customer focus is a key requirement of ISO 9000:2000. For example, in the Management Responsibility section, one requirement is “Top management shall ensure customer requirements are determined and are met with the aim of enhancing customer satisfaction”. This puts the responsibility

for customer focus on senior management (Evans and Lindsay 2008, Crosby 1979).

For business enterprises, the significant driving force to establish the quality goals basically originates from customer needs. Generally speaking, customer needs identify the operational goals for firms to meet. And this type of quality goals is also referred as market-driven (Juran, 1992). Aaker, *et al*, 2007 mentioned that quality started with the understanding of customer needs and ended when those needs were satisfied. In order to meet the requirement of customers, top management should clarify the expectations of its customers.

Further, organizational strategy should also be developed based on customers’ needs Etienne-Hamilton (1994). Kumar and Balakrishnan (2011) pointed out that customer focus is the underpinning principles for firms to implement TQM programs. Since senior management may have the influence and authority to dominate the entire TQM implementation, dedicated commitment from top management about implementing TQM is certainly a necessity.

III. RESEARCH DESIGN

The research adopted a descriptive study design. Data was typically collected through questionnaire, and interview. It embraced a large proportion of the market research and provided a snapshot of some aspect of the market environment. (Gay, 1981 , Mugenda, *et al*, 1999, Dawson, 2002). The research employed a sample size of 116 respondents. This was arrived at after using ten (10%) of each stratum obtained from all departments. The actual respondents were selected randomly from each population sub-group as indicated in Table 2 below.

Table 2: Sample Frame and Sample Size.

Department	Sample Frame	Sample Size	Percentage of total sample (%)
Procurement	120	12	10.34%
Information Technology	90	9	7.76%
Medical	130	13	11.21%
Marine Operations	220	22	18.97%
Marine Engineering	250	25	21.55%
Civil Engineering	240	24	20.69%
Internal Audit	50	5	4.31%
Ethics & Integrity	60	6	5.17%
Total	1,132	116	100.00%

Source: Researcher (2014)

IV. RESEARCH FINDINGS AND DISCUSSIONS

4.1 Results and Discussion

In the study, a total of 116 questionnaires were distributed of which 74 were successfully filled, returned and taken as valid samples.

Table 3: Response rate

Questionnaires issued	Returned	% return rate
116	74	64%

According to Mugenda and Mugenda (1999) a 50% response rate is adequate, 60% good and above 70% rated very good. This implies that basing on this assertion; the response rate in this case

of 60% was good. It is therefore apparent that the respondents were willing and could freely share the required information on KPA’s Quality Management Systems.

Table 4: Gender response to effects of Quality Management Systems in KPA

		Frequency	Percent	Valid Percent	Cum. Percent
Valid	MALE	47	63.5	63.5	63.5
	FEMALE	27	36.5	36.5	100.0
	Total	74	100.0	100.0	

The finding from the table 4 above indicates that the majority of the respondents were male with 63.5% of the response while the female contribution was 36.5% of the total valid sample size. This is a clear indication that male staffs were more active in the exercise than their female counterpart. It also

emerged that females were not ready to respond to various questions resulting to their low returns. This was an evident that the females were not fully involved in the quality management systems in the enhancement of performance in KPA.

4.1.1 The Commitment of management to QMS

Table 5: Descriptive Statistics on Commitment of Management to QMS in the performance of Kenya Ports Authority

	N	Min	Max	Mean	Std. Deviation
Provision of quality service to its stakeholders	74	1	2	1.26	.440
Creating and sustaining, clear visions, goals, targets and shared values	74	1	2	1.22	.414
Management ensures control through the establishment	74	1	3	1.62	.590

of benchmarks, standards and feedbacks					
Workshops on importance of quality management conducted periodically	74	1	3	1.59	.571
There is necessary achievement of results through action plans and projects	74	1	4	2.49	.745
Valid N (listwise)	74				

Findings in table 5 above shows the statistics on commitment of management to Quality Management Systems in Kenya Ports Authority as it indicates a mean of 1 to 2.5 which is between strongly agree and agree that the management is committed. This data also implies that standard deviation (0.4 – 0.7) on management commitment to QMS is positively skewed on the normal distribution curve thus not widely distributed. It is therefore evidence that the KPA Management is committed to QMS in the organization. The respondents were in total agreement to the creation and sustaining clear vision, goals, targets and shared values in ensuring commitment to quality is

achieved where a mean of 1.22 respondents were between (1 – 2) strongly agreed and agreed as per Likert scale respectively in enhancing quality performance in the organization.

It is therefore evident that the Authority’s Management is firmly committed to the development and implementation of the Quality Management System through; provision of quality service to its stakeholders, creating & sustaining, clear visions, goals, targets and shared values, establishment of benchmarks, standards & feedbacks and conducting regular management reviews as per the documented procedures.

Table 5.1: Correlations between Provision of Quality Service to its Stakeholders and Creating & sustaining, clear visions, goals, targets and shared values

		Provision of quality service to its stakeholders	Creating & sustaining, clear visions, goals, shared values
Provision of quality service to its stakeholders	Pearson Correlation	1	.894**
	Sig. (2-tailed)		.000
	N	74	74
Creating and sustaining, clear visions, goals, targets and shared values	Pearson Correlation	.894**	1
	Sig. (2-tailed)	.000	
	N	74	74

** . Correlation is significant at the 0.01 level (2-tailed).

The analysis shows a correlation coefficient of 0.894 and a significance of 0.000. The significance is <0.05 and indicates that there is strong linear relation between provision of quality

services to creation of clear vision, goals, targets and shared values in the organization.

Table 5.2:Correlations between Necessity to achieve results by action plans and periodical workshops on quality management systems.

		Workshops on importance of quality management conducted periodically	There is necessary achievement of results by action plans and projects
Workshops on importance of quality management conducted periodically	Pearson Correlation	1	.965**
	Sig. (2-tailed)		.000
	N	74	74
There is necessary achievement of results through action plans and projects	Pearson Correlation	.965**	1
	Sig. (2-tailed)	.000	
	N	74	74

** . Correlation is significant at the 0.01 level (2-tailed).

The analysis shows a correlation coefficient of 0.965 and a significance of 0.000. The significance is <0.05 and indicates that there is strong linear relation between necessity to achieve results

by action plans and periodical workshops on quality management systems in the organization.

Table 5.3: Periodical Workshops on Quality Management and Control through benchmarks, standards and feedbacks

	Management's control by establishment of benchmarks	Workshops on quality management
Management's control by establishment of benchmarks	Pearson Correlation Sig. (2-tailed) N	.920** .000 74
Workshops on quality management	Pearson Correlation Sig. (2-tailed) N	1 .000 74

** Correlation is significant at the 0.01 level (2-tailed).

The analysis shows a correlation coefficient of 0.920 and a significance of 0.000. The significance is <0.05 and indicates that there is strong linear relation between periodical workshops on

quality management and control through benchmarks, standards and feedbacks in the organization.

4.1.2 Employees' involvement to QMS

Table 6: Descriptive statistic on employees' involvement

	N	Min	Max	Mean
Employees are fully involved in the organization's quality management decision making processes	74	2	5	2.91
Employees are well trained on integration and appropriate use of statistical tools and problem solving methods	74	2	5	3.81
Does staff establish quality improvement teams, corrective action teams and suggestion schemes	74	1	4	2.09
Empowerment of employees by delegating authority to make decisions regarding process improvement within individual areas of responsibility.	74	1	5	2.09
Valid N (list wise)	74			

Majority of the staff represented by 58.1% percent reveals that KPA management does not fully involve employees in quality management decision making process with 1.4% percent strongly disagreeing with management in involving them. This is represented by a mean score of 2.91 as per table 6 above. Some respondents said they are only involved in implementation of the decisions made thus leaving them with no room to share their views on how to better the QMS in the organization. Table 6.1 illustrates the outcome. Only 40.5% agree that they are well trained on integration and appropriate use of statistical tools and problem solving methods, 29.7% are not sure while 28.4% disagree with 1.4% strongly disagreeing. From the respondents sampled, it was clear that the management was selective on nomination of personnel for training and this affects performance of the organization negatively.

Table 6 above shows that there were some positive responses from respondents with a mean of 2.09 of the valid results

showing that staffs establish quality improvement teams, corrective action teams and suggestion schemes which enhance performance of Kenya Ports Authority. 24.3% and 44.6% strongly agreed and agreed respectively that they do establish teams for enhancing performance. 28.4% were not sure while 2.7% disagreed with the point as illustrated in table 6.3 below.

A representation of 70% of the respondents reveals that the Kenya Ports Authority management empowers and encourages delegation of duties and ensure proper decisions regarding process improvement within individual areas of responsibility are made. 24.3% strongly agreeing and 48.6% agree, 21.6% were not sure of delegated duties to them while 4.1% and 1.4% disagreed and strongly disagreed respectively on empowering and delegation of duties within the organization as shown in table 6.4 below.

Table 6.1 Employees are fully involved in the organization’s quality management decision making processes

		Frequency	Percent	Valid Percent	Cum Percent
Valid	agree	30	40.5	40.5	40.5
	not sure	22	29.7	29.7	70.3
	disagree	21	28.4	28.4	98.6
	strongly disagree	1	1.4	1.4	100.0
Total		74	100.0	100.0	

Table 6.2: Employees are well trained on integration and appropriate use of statistical tools and problem solving methods

		Frequency	Percent	Valid Percent	Cum Percent
Valid	agree	11	14.9	14.9	14.9
	not sure	14	18.9	18.9	33.8
	disagree	27	36.5	36.5	70.3
	strongly disagree	22	29.7	29.7	100.0
Total		74	100.0	100.0	

Table 6.3: Establishment of quality improvement teams, corrective action teams and suggestion schemes

		Frequency	Percent	Valid Percent	Cum Percent
Valid	strongly agree	18	24.3	24.3	24.3
	agree	33	44.6	44.6	68.9
	not sure	21	28.4	28.4	97.3
	disagree	2	2.7	2.7	100.0
	Total	74	100.0	100.0	

Table 6.4: Empowerment of employees by delegating authority to make decisions regarding process improvement within individual areas of responsibility

		Frequency	Percent	Valid Percent	Cum. Percent
Valid	strongly agree	18	24.3	24.3	24.3
	agree	36	48.6	48.6	73.0
	not sure	16	21.6	21.6	94.6
	disagree	3	4.1	4.1	98.6
	strongly disagree	1	1.4	1.4	100.0
Total		74	100.0	100.0	

The top management’s role is to provide the environment where people are empowered to realize the organization’s objectives. Top management needs to establish the quality policy, ensure the quality objectives are established at relevant functions and levels in the organization, communicates to all employees on the importance of meeting customer as well as stator and regulatory requirements, conduct management reviews and ensure the availability of resources.

Involving employees, empowering them, and bringing them into decision making process provides the opportunity for continuous process improvement. The untapped ideas, innovations, and creative thoughts of employees can make the difference between success and failure. Competition is so fierce that it would be unwise not use every available tool.

4.1.3 Cultural behavior in enhancing quality and productivity

Table 7: Descriptive statistics on Cultural behavior in enhancing quality

	N	Min	Max	Mean
Enlightened on cultural values that enhance organization’s performance	74	1	3	1.74
In place, a central core values into which management and other employees follow	74	1	3	2.19
Teamwork encouraged by management	74	1	3	2.01

Understanding of the organizational mission, your part in it and what has to be done to achieve it	74	1	4	2.27
Proper safety gears provided for employees protection	74	1	2	1.50
Valid N (list wise)	74			

The mean of 1.74, in table 7 above, implies that cultural values that enhance organizational performance are enlightened within KPA employees. A 39.2% of respondents strongly agreed while 47.3% of the respondents agreed that organizational culture enhance performance, table 7.1 below illustrates. With respondents ranging between 1-3 in the given scale (Likert), table 7 above, it is evident that organization has central core values into which management and other employees follow. This implies all employees have a role in enhancing quality through the centralized core values. 9.5% and 62.2% strongly agreed and agreed respectively on the central core values. Only 28% were not sure as indicated in table 7.2 below.

As reflected from the findings, 17.6% and 63.5% strongly agreed and agreed respectively that teamwork was encouraged in the performance of activities in the organization as can be seen in the table 7.3 below. Around 74.4% of the respondents were positive on the understanding of the organizational mission, their part in it and what they need to do to achieve the goals. 20.3% were not sure while 7.4% disagreed on understanding of the organizational mission, their part in it and what they need to do in achieving the organizational goals. Table 7.4 below illustrates the results. According to table 7.5 below, the respondents were positive on provision of proper safety gears at their workplaces. 50% - 50% of the respondent strongly agreed – agreed on safety gears being provided.

Table 7.1: Enlightened on cultural values that enhance organization’s performance

		Frequency	Percent	Valid Percent	Cum. Percent
Valid	strongly agree	29	39.2	39.2	39.2
	agree	35	47.3	47.3	86.5
	not sure	10	13.5	13.5	100.0
	Total	74	100.0	100.0	

Table 7.2: A central core values into which management and other employees follow

		Frequency	Percent	Valid Percent	Cum. Percent
Valid	strongly agree	7	9.5	9.5	9.5
	agree	46	62.2	62.2	71.6
	not sure	21	28.4	28.4	100.0
	Total	74	100.0	100.0	

Table 7.3: Teamwork encouraged by management

		Frequency	Percent	Valid Percent	Cum. Percent
Valid	strongly agree	13	17.6	17.6	17.6
	agree	47	63.5	63.5	81.1
	not sure	14	18.9	18.9	100.0
	Total	74	100.0	100.0	

Table 7.4: Understanding of the organizational mission, your part in it and what has to be done to achieve it

		Frequency	Percent	Valid Percent	Cum. Percent
Valid	strongly agree	3	4.1	4.1	4.1
	agree	52	70.3	70.3	74.3
	not sure	15	20.3	20.3	94.6
	disagree	4	5.4	5.4	100.0
	Total	74	100.0	100.0	

Table 7.5: Proper safety gears provided for employees protection

		Frequency	Percent	Valid Percent	Cum. Percent
Valid	strongly agree	37	50.0	50.0	50.0
	agree	37	50.0	50.0	100.0
	Total	74	100.0	100.0	

The Authority has ensured the cultural norms are measured by things like as amount of work done and also the level of cooperation between management and employees of the organization. Clearly rules are defined for employee’s behavior associated to the productivity, intergroup cooperation and customer relationship. Observed behavioral regularities, as

illustrate common language and formal procedures in encouraging teamwork at all times. Coordination and integration between the organizational units for the purpose of improvement in efficiency to works, quality and speed of designing, services by understanding organizational mission and objectives.

4.1.4 Customer focus and satisfaction

Table 8: Descriptive statistics on Customer focus and satisfaction to performance

	N	Min	Max	Mean
Organization establishes and understand current and future customer needs	74	1	3	1.45
Organization ensures that it communicates and balances the needs and expectations of all interested parties	74	1	2	1.47
Management measure customer satisfaction and rectifies where necessary	74	1	2	1.47
Management responses to customers' complaints	74	1	2	1.38
Are you satisfied with the level of service delivery to customer	74	1	5	1.62
Valid N (list wise)	74			

The findings imply that Kenya Ports Authority is customer oriented and that it practices quality management by complying with products conformity. This is evident from table 8above, where the mean score ranges between 1.38 to 1.6 which shows that customer focus is one of the pillars in the Authority’s performance. Most respondents are agreeable with the current trend in the organization as they are aware of their customer needs as shown in table 8.1 below with 98.6% positive results. The respondents, through the scale, 56.8% strongly agreed and 47.3% agreed that communication is also an area which the organization has given weight in line with ensuring that the organization communicates and balances the needs and expectations of all stakeholders as shown in table 8.2 below.

of 52.7% strongly agreed that the management measures customer satisfaction and rectifies where necessary while 47.3% agreed, leaving no room for other views as it all accumulated to 100% of the respondents. Table 8.3 evidently shows the findings.

The valid 74 respondents of the 116 that returned their questionnaires confirmed that the response rate of the management to customer complaints was positive and that it is one way of ensuring that a customer is maintained at all costs. Table 8.4 illustrates the managements concern to their customers’ needs. It however emerged that 9.5% of the respondents were not satisfied with the level of service delivery to their customers. Table 8.5 shows that 6 respondents were not sure while 1 respondent strongly disagreed with the service delivery level to their customers.

It was noted from the respondents that the management has the mechanism in place to measure their customer satisfaction and correct areas which have some non-conformities. A sample

Table 8.1: Organization establishes and understands current and future customer needs

	Frequency	Percent	Valid Percent	Cum. Percent
Valid strongly agree	42	56.8	56.8	56.8
agree	31	41.9	41.9	98.6
not sure	1	1.4	1.4	100.0
Total	74	100.0	100.0	

Table 8.2: Organization ensures that it communicates and balances the needs and expectations of all interested parties

	Frequency	Percent	Valid Percent	Cum. Percent
Valid strongly agree	39	52.7	52.7	52.7
agree	35	47.3	47.3	100.0
Total	74	100.0	100.0	

Table 8.3: Management measure customer satisfaction and rectifies where necessary

		Frequency	Percent	Valid Percent	Cum. Percent
Valid	strongly agree	39	52.7	52.7	52.7
	agree	35	47.3	47.3	100.0
Total		74	100.0	100.0	

Table 8.4: Management responses to customers' complaints

		Frequency	Percent	Valid Percent	Cum. Percent
Valid	strongly agree	46	62.2	62.2	62.2
	agree	28	37.8	37.8	100.0
Total		74	100.0	100.0	

Table 8.5: Are you satisfied with the level of service delivery to customer?

		Frequency	Percent	Valid Percent	Cum. Percent
Valid	strongly agree	37	50.0	50.0	50.0
	agree	30	40.5	40.5	90.5
	not sure	6	8.1	8.1	98.6
	strongly disagree	1	1.4	1.4	100.0
Total		74	100.0	100.0	

The organization regards customer requirements and satisfaction as an important aspect of its business operations. Organization ensures that it communicates and balances the needs and expectations of all interested parties. Customer focus is seen as a key performance indicator within business and is often

part of a Balanced Scorecard. In a competitive marketplace where businesses compete for customers, customer satisfaction is seen as a key differentiator and increasingly has become a key element of business strategy.

4.1.5 Processes and procedure measurement

Table 9: Descriptive statistics on process and procedure measurement

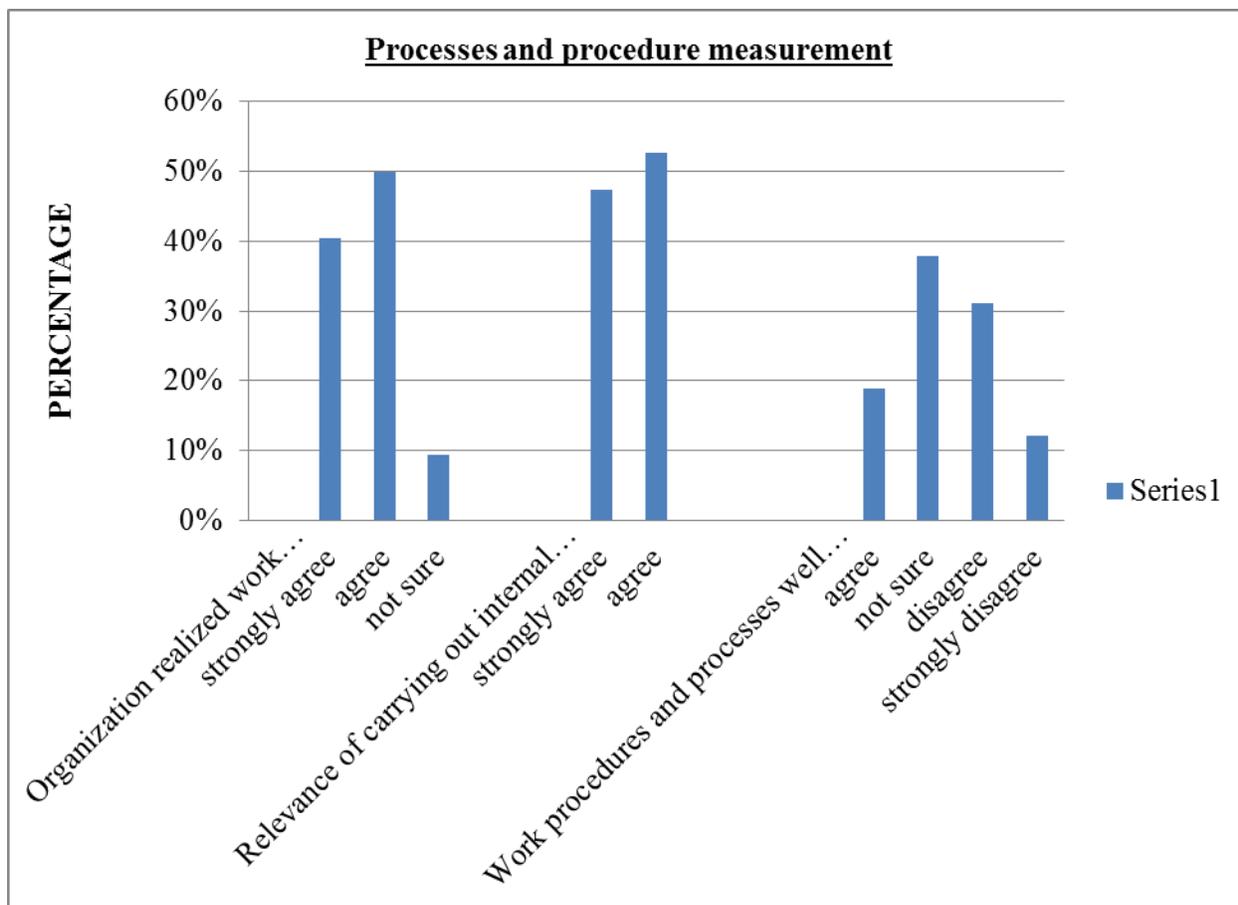
	N	Min	Max	Mean
Organization realized work improvement since inception of ISO	74	1	3	1.69
Relevance of carrying out internal audits	74	1	2	1.53
Work procedures and processes well documented and followed	74	2	5	3.36
Valid N (list wise)	74			

In the findings, most of the respondents were of the opinion that since inception of ISO in the organization, work improvement have been realised with a 40.5% strongly agreeing and 50% agreed. Only 9.5% were not sure and did not comment anything as prefigure 2 below.

The respondent were also in agreement that carrying out quality audits periodically was relevant in checking whether

work procedures were being followed in enhancing quality performance as illustrated in figure 2 below, with 47.3% strongly agreeing to the relevance of audits and 52.7 agreeing to the same. Therefore a positive finding was registered with a mean of 1.53 as shown in table 9 above.

Figure 2: Processes and procedure measurement



The Authority is seen having established and maintained relevant procedures for inspecting all process inputs to ensure that both the customer's and the Authority's requirements for the product and services are met.

V. SUMMARY OF MAJOR FINDINGS

Major findings indicate that the management has positively embraced quality initiatives in the organization by ensuring that the entire KPA staffs are aware of the importance of quality performance in enhancing achievements at all levels. The findings of this study results revealed that commitment of management to QMS in the performance of KPA was through provision of quality services to KPA stakeholders, creating and sustaining clear vision, goals targets and shared values which was posted as positive with a mean=1.69.

It was also noted that the managements' commitment ensured control through establishment of benchmarks, standards and feedbacks on activities being undertaken as all was geared towards achieving quality performance in KPA (mean=1.74). Workshops on QMS were positively conducted resulting into a mean of 2.05. It was also clear that the commitment of management ensured the necessity of result achievement through action plans and projects. Generally it was noted that commitment of management strongly affects performance positively through QMS. Employees' involvement to QMS in the

performance of Kenya Ports Authority was seen to be on the negative as they were not fully involved in decision making processes thus erstwhile ideas were not given to the management for inclusion in the decision making. Cultural behavior in enhancing quality and productivity on performance of Kenya Ports Authority. Training was also not given priority as a mean score of 3.81 shows little or few individuals were given the opportunity to train on statistical tools and problem solving methods.

According to the statistics, customer focus was found to be a focal point where the management and employees were required to strive in achieving quality results that satisfy the needs of their customers. It is seen through the response rate (mean=1.47) that communication is an area viewed with much concern that it ensures customers' expectations are attended to with utmost urgency. The management has also put in place mechanism of ensuring they measure their customer satisfaction through feedback reports. The statistics also shows that the managements' response rate to customer complaints is high to avoid losing customers to competitors.

The processes and procedure measurement to effective performance of Kenya Ports Authority has shown a major milestone since implementation of ISO in the organization has improved work since its inception, (mean=1.69), the staff confirmed importance of carrying out internal audits periodically

as it ensures the employees follow the procedures required in enhancing quality performance.

KPA establishes and understand current and future customer needs to a mean score of 1.45, it also balances the needs and expectations of all interested stakeholders to a mean score of 1.47, measures customer satisfaction and rectifies where necessary to a mean score of 1.47 and respond to customer complains to a mean score of 1.38. This implies that KPA needs to put more effort to ensure customer satisfaction since customers are the determinants of success or failure of a business.

The research findings imply that the major challenge in KPA's implementation of QMS is cascading the program to the bottom of the pyramid. Management should ensure training on integration and appropriate use of statistical tools and problem solving methods be done to all employees without choosing their various levels in the organizational hierarchy. Workshops on quality awareness to all staff levels should ensure coverage of both staff working on shift and those on normal working hours to avoid managing teams that cannot integrate easily in enhancing performance. Efforts should be done to mitigate the above challenges for successful implementation of Quality Management Systems in KPA.

VI. CONCLUSIONS

Quality management systems in any organization are a crucial factor in efficient and effective leadership for successful functioning of any organization.

1. The study finding concludes that effective management leads to improved performance, there is need to put more emphasis on all quality services or products to ensure more organization business performance, tools in process approach need to be fully employed in enhancing quality services in KPA.
2. There is also need to focus more on already established factors like management response to customer' complaints, service delivery to customers and organization communication and balancing the needs and expectation of interested parties which have an impact on customer satisfaction.
3. Personnel training on issues that directly affect performance of the organization is seen as a grey area as most employees are not satisfied with the mode of selection for training, citing that specific individuals could be chosen to undertake various courses while the Authority has other potential staff with same training requirements.
4. Most employees maintain that the organization should understand the current and future needs of customers; they also agree that business performance and customer satisfaction are enhanced by quality management practices.
5. The study findings also infer that use of process approach in defining the activities necessary to achieve desired results, evaluating risks, consequences and impacts of activities on

customers and other stakeholders have a major impact on performance at KPA.

6. Analyzing and measuring of the capabilities of key activities can also have a major impact on organization performance.
7. The findings further established that quality, customer satisfaction, maintaining the effectiveness of quality management system and compliance with customer and regulatory requirements are the personal responsibility of every employee.
8. Maintaining the results of the review, and any subsequent follow-up actions. Auditing is seen as a guide to ensure QMS adhered to and regular checks provides the employees with the confidence on the required standards that ensure product/service delivery and conformity to the requirements thus continual improvement.

VII. RECOMMENDATIONS

1. The study recommends that emphasis should be put on the incorporation of all the principles of Quality Management Systems for successful quality performance for the success of the organization.
2. The role of management commitment, employee involvement, organizational culture and customer focus are apparent for the success of the organization in terms of market share, productivity, profitability and overall business performance.
3. Improved quality performance has positive effects on overall business achievements.
4. Improving on quality series or products to satisfy customer's needs does pay off since the benefits accrued include; improved quality, employee satisfaction, productivity, employee participation, teamwork, communication, profitability and market share.
5. The study recommends that firm should establish their quality management systems according to the requirement of ISO standards effectively for effective equality services and for the success of the firm.
6. Flexibility of the organizational culture will determine the success or failure of achieving quality services or products.
7. Resistance to change, lack of commitment, cascading the program to the bottom of the pyramid are some of the challenges faced in management of quality systems in an organization.
8. The study recommends that firms should be flexible enough when implementing quality standards and management should develop a quality culture by changing perception and attitudes towards quality.
9. Organization inflexibility and inertia has provided an environment that weakened and erodes the foundation of quality.

Areas for Further Research

Further research can be performed to expand research scope to different industries or investigate the implementation situation in public and private companies and also in small- and medium-size companies. Moreover, quality management can integrate firm's internal and external processes with knowledge creation processes. Thus, future researches can be performed to consider integrating the relationship, studying the synergies between Quality Management Systems practices and measuring how economic effects of workforce can enhance performance on added firm's value.

REFERENCES

- [1] Aguayo, Rafael (1991), Dr. Deming: The American Who Taught the Japanese About Quality. USA: Touchstone publishers.
- [2] BSI (1991), BS4778 Quality Vocabulary. Availability, reliability and maintainability terms. Guide to concepts and related definitions. BSI.
- [3] Bowen Rondah (2013) Theories in Total Quality Management. Retrieved on 28, January, 2015 from Slideshare website: <http://www.slideshare.net/mendezmeaganrose/theories-in-total-quality-management>
- [4] Huczynski, A. and Buchanan, D. (2013), Organizational Behavior, [8th Ed.], Harlow: Pearson.
- [5] Cane, Sheila (1996), Kaizen Strategies for Winning Through People. London: Pitman Publishing.
- [6] Chong, C. Y. (2006), The Implementation of Quality Management System in Analyzing the Workmanships' Performance of Projects. Unpublished thesis of University of Technology, Malaysia.
- [7] Crosby, P. B. (1979), Quality is Free. London.: McGraw Hill,
- [8] Dawson, Catherine, (2002), Practical Research Methods, New Delhi: UBS Publishers' Distributors.
- [9] Durai A. K, and Dr. V. Balakrishnan (2011), A Study on ISO 9001 Quality Management System Certifications – Reasons behind the Failure of ISO Certified Organizations, Global Journal of management and Business Research, Volume 11 Issue 9 Version 1.0, September 2011. Retrieved on 14, August 2014 from global journals online database
- [10] Etienne-Hamilton (1994), E.C. Operations Strategies for Competitive Advantage: Text and Cases. Fort Worth, TX: The Dryden Press.
- [11] Ali B.J and Abedalfattah Z .A (2012) The Effect of Quality Management Practices on Organizational
- [12] Performance in Jordan: An Empirical Study, International Journal of financial research vol.4No.1 2013. Retrieved on 5, January 2015, from science and education website: URL: <http://dx.doi.org/10.5430/ijfr.v4n1p93>
- [13] Feigenbaum, A. V. (1961), Total Quality Control, New York: McGraw Hill.
- [14] Gay, L. R. (1981), Educational Research: Competencies for analysis and application. Collumbus, :Charles E. Mairill Publishing Company A. Bell & Howell Company.
- [15] Gerald A. Cole and Phil Kelly (2011), Management: Theory and Practice, [7Ed], Hampshire, UK: South-Western Cengage Learning
- [16] Goetsch, D. L. & Davis, S. B. (2013), Quality Management for Organizational Excellence: Introduction to Total Quality. [7th Ed.], NJ: Pearson,
- [17] Hakes, Chris (2009), A management guide the EFQM Excellence model for assessing organizational Performance. [2nd Ed.]. England. UK: Van Haren Publishing
- [18] James R. Evans and William M. Lindsay, (2008), The Management and Control of Quality, [7th Ed.], Thomson: South-Western Publisher.
- [19] Juran, Joseph (2009). Juran' s Quality Handbook. [6th Ed.] New York. USA: McGraw Hill Publications,
- [20] KPA 2013-2014 (2013) Kenya Ports Authority Handbook. Retrieved on August 15, 2014 from Kenya Ports Authority website: <https://www.kenyaembassy.com/pdfs/handbookimportingexporting.pdf>
- [21] Kothari, C.R. (1985), Research Methodology- Methods and Techniques, New Delhi :Wiley Eastern Limited.
- [22] Kumar, Ranjit, (2005), Research Methodology-A Step-by-Step Guide for Beginners, [2nd Ed], Singapore : Pearson Education.
- [23] Mugenda, Olive and Abel Mugenda (2003). Research Methods-Quantitative and Qualitative Approaches, [2nd Ed.] Nairobi: Acts Press.
- [24] Nanda, V. (2005), Quality management system handbook for product development companies. New York: CRC Press.
- [25] Richard L. Daft (2011), Organizational Theory, Change and Design, Seventh Indian Edition, South-Western Publisher.
- [26] Soltani, E. (2005), Top management: a threat or an opportunity to TQM? Total Quality Management, Vol16 No.4, pp. 463-476. June 2005. Retrieved on 11 December, 2014, from Taylor and Francis electronic databases.

AUTHORS

First Author-Daniel Jonai Matata, Planning Technician Kenya Ports Authority (KPA) Mombasa, Kenya Email: dmataaj@gmail.com

Second Author-Moses Kimani Wafula, Senior Assistant Librarian, Jomo Kenyatta University of Agriculture and Technology Mombasa CBD, Email: wafulak@jkuat.ac.ke

Effects of Strategic Positioning of Service Delivery on Customer Satisfaction - A Case Study of FINA Bank

Asaph Ngetha Kamau *, Moses Kimani Wafula **

*Transactions officer Guaranty Trust Bank Mombasa-Branch, P.O Box 90089-80100

** Senior Assistant Librarian Jomo Kenyatta University of Agriculture and Technology Mombasa CBD, P.O Box 81310-80100, Mombasa

Abstract- This paper investigates the effects of strategic positioning of service delivery on customer satisfaction a case of Fina Bank Mombasa. Several publications, reference materials as well as some unpublished literature are used to compile the literature review with discussion on the topic under study. At the time of study, the population comprised of customers and the staff totaling to 250 respondents. The researcher issued out 250 questionnaires and received 67. Respondents were grouped into strata's under their departments. Data collection was through questionnaires. Both qualitative and quantitative techniques were used to analyze the data collected. Majority the respondents agreed that strategic positioning of service delivery within an organization has a positive impact on customer satisfaction.

Index Terms- Strategic positioning, customer segmentation, service delivery, customer, enterprise satisfaction, small and medium-sized co-operate clients

I. INTRODUCTION

In today's increasing competitiveness nature in the banking and financing industry, a key challenge for banks is to cut through the noise of competing and substitute products and service to attract the attention of the consumer. The word strategy comes from a Greek word known as *strategia*, which was used in military terms and represent had times which requiring the people in charge of making decision to make good use of the available and existing resources to win a war. strategic service delivery implies a strong focus on competition, product branding and service delivery. Since competition in banking and financing sector was rapidly increasing in terms of service delivery, bankers have to attract more customers through strategic service delivery efforts to improve on their services. In order to achieve this and improve their market and profit positions, many retail banks were directing their strategies towards increasing customers' satisfaction and loyalty through improved service quality. In a fiercely competitive market, non-price factors like customer service become more important hence; it was desirable for banks to develop a customer-centric approach for future survival and growth. (Veneeva, 2006, Kotler, 2003).

It has always been known that prompt, efficient and speedy customer service alone will retain the existing customers to continue and induce new customers to try the services offered by a bank. Further, it had been realized that a number of banks had miles to go to capture the recent trends and to be at par with the modern banks in service delivery. As a result, many banks have introduced new customer friendly measures such as 24-hour

banking, seven-day and anywhere banking, internet banking, extended business hours, ATM network, corporate banking, mobile banking etc to remain competitive in the market. Today, customers are increasingly becoming aware of the options and offers banks provide in retaining them as potential customers. (Krishnaveni & Divya Prava, 2004, Sachdev & Verma, 2004, Aurora and Malhotra, 1997).

Positioning can be defined as collection of creative activities that manipulates the consumers' mind in favor of the brand. The emphasis was that positioning starts with a product and ends up creating a space and occupying it in the consumers' minds. its argue that a well-known brand only holds a distinctive position in consumer's mind which may be difficult for the competitors to claim, and that this position would only be maintained with well-articulated strategies concerning product, price, place, and promotion (Ries, 1986).

In December 2011, Fina bank was a medium-sized financial services provider, providing commercial banking services to individuals and organizations. Its emphasis was to serve small and medium-sized corporate clients ("SMEs"). The bank was the flagship institution of the Fina Bank Group, which includes Fina Bank (Rwanda) and Fina Bank (Uganda). As of December 2010, the asset valuation of Fina Bank (Kenya) was estimated to be approximately \$US 171 million (KES:14.1 billion). The history of Fina Bank (Kenya) dates back to 1986 when Finance International Limited was incorporated in Nairobi, as a "Non-Banking Financial Institution" (NBFI). The name of the institution was later changed to The Finance Institution of Africa (FINA). Ownership of FINA changed in 1991 and the current owners assumed control of the company.(*Financial advisory magazine*, 2012)

A banks service can be affected by economic, technological, demographic, socio-cultural, political and legal factors. With an increasing number of commercial banks in Kenya, banks are now competing for attention for sustainability. From the demand of banking services and facilities perspective, the explosion in brand choice and brand publicity material has increased the confusion among potential consumers. Initially Banks have served as one of the main underpinnings of society since civilization began. They have slowly evolved over the centuries, moving slowly from simple counting houses and places to store physical treasures to the modern institutions of today. Banks now offer products and services that were undreamed of even in the later days; they still provide traditional services such as checking and savings accounts, certificates of deposit and safe deposit boxes. But they now provide a wealth of electronic benefits that can rival those of any other type of retail financial institution (Wiersema, 1994 Treacy, 1994).

For effective positioning strategy to happen it must be beneficial to the marketer and consumer in this case the bank. This was because positioning was underpinned by the philosophy of understanding and meeting unique consumer needs, (Manhas, 2010). Effective positioning offers the customer benefits tailored to solve a problem related to their needs. In a way that was different to competitors. For the organization, the value of positioning lies in the link it provides between the analysis of the internal corporate and external competitive environments. This is fundamental to the definitions of strategic marketing, which point to the matching of internal resources with environmental opportunities (Chacko, 1997, Pike & Ryan 2004).

Customer satisfaction and services delivery are what modern banks employ to increase and improve their service delivery thus customer retention. Therefore positioning products is central to developing strong customer base and brand equity. The target market and the perceived differentiation from competitors are seen as core concepts of positioning, (Rao & Steckel1998). Positioning is a relevant strategic concept, and a major development in consumer marketing, which has equal applicability for industrial products and services. (Webster 1991), Webster furthered echoed that Positioning of the company values, through its services was a unique way the firm delivered value to its customers.

Competition had made banks marketing management to adopt strategic concepts and tactics in positioning their services so as to impart value to their customers. Bank service in Kenya can be well positioned through non-functional and functional benefits, non functional benefits involves bank corporate identity and image, whereas functional benefits comprises of developing new attributes for the products or altering old attributes of the old products so as to improve customers satisfaction, (Ojung'a, 2005).

Strategic positioning of banking services/products was a concept which most banks undertake so as to be more competitive in the financial industry in Kenya. For banks to attract more customers they must ensure that their services deliver value satisfaction for their customers. The ideal vision of strategically positioning of the bank service and products was to be distinguishable from competitors along real dimensions to be the most preferred bank for a certain market segment or prospects it's an attempt to have a unique and clear position in the market place. The image-making bank seeks to cultivate an image in the customers eyes and mind, positioning was a process of establishing and maintaining distinctive place and image in the market for an organization or its individual product/service offering so that the target market or prospects understands and appreciates what the organization stands for in relation to its competitors (Zineldin1996, Trout1986)

1.3.1 General objective

The study aimed to investigate the effects of strategic positioning of service delivery on customer satisfaction at Fina bank.

1.3.2 Specific objectives

1. To determine the effects of technology advancement on customer satisfaction at Fina bank.
2. To analyze the effects of product classification on customers satisfaction at Fina bank.
3. To investigate how customer segmentation enhance customer satisfaction in fina bank.
4. To find out the effects of brand benefits contribute on customer satisfaction

II. LITERATURE REVIEW

Customer Bonding : The Driving Force in Shaping Strategy

Classic strategy frameworks emphasize a product orientation where the company competes against rivals and the winner is determined by who has the best product.

These companies tend to commoditize customers by offering standardized products through mass distribution channels that can inhibit contact with end-customers. The intimacy and connectivity of a networked economy, however, offer opportunities to create constructive, long-term relationships with customers that lead to an unbreakable link that we refer to as "customer bonding", a mutually beneficial engagement based on trust and transparency. To achieve bonding, you must promote investments in and around the product by customers and complementary (firms that deliver products and services that enhance or augment the company's products), that customers cannot easily walk away from and the company can use to customize its offering. Investments in these "collateral" assets, both financial and time, such as learning how to use the product, incorporating customer-specific data, integrating purchased add-ons, and customizing interfaces to the product, can increase switching costs and bonding. The Delta Model provides an expanded set of strategic positions that incorporate customer bonding.

The Triangle : A New Set of Strategic Positioning

There are three distinct strategic options, which offer very different approaches to achieve customer bonding:

Best Product - Low cost or differentiation: commoditization of customers limits opportunity for bonding, total Customer Solution - Reducing customer costs or increasing their profits: enhancing the customer's economics can lead to stronger bonding, system Lock-in - Complement or lock-in, competitor lock-out, or proprietary standard: identifying, attracting and nurturing complementary can further increase the value of your offering and the strength of your customer bonding (source Hax, 2009).

The System Lock-In and Total Customer Solutions options offer new ways to compete that deviate substantially from conventional "best product" strategic positioning, and provide increasing levels of customer bonding

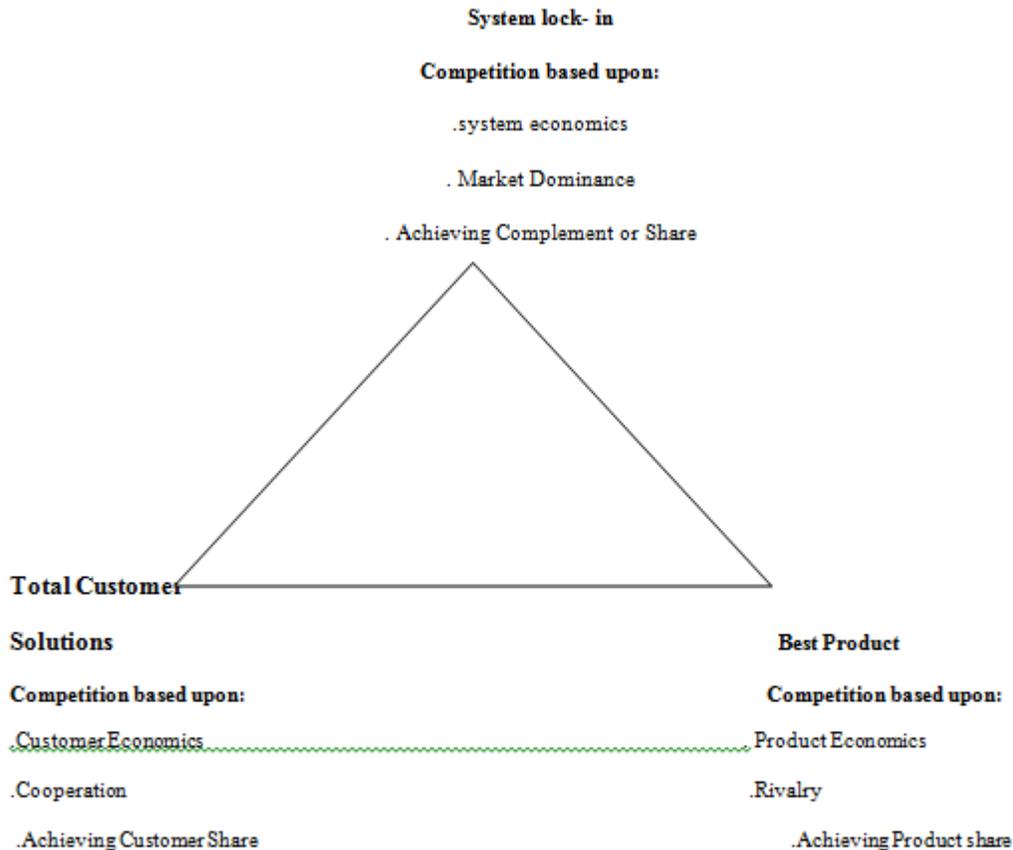


Figure 1 Delta model triangle. A new set of strategic positioning of products and services
 (source Hax, 2009)

2.2.6 System Lock-in

The System Lock-In option was the widest scope; it includes the extended enterprise - the firm, its customers, suppliers, and most importantly, "complementary" – and can lead to the highest level of bonding. While the customer continues to be the central focus, the key to this strategic option was to identify, attract, and nurture the complementary. They are rarely detected and exploited effectively – we must identify and incorporate all the key external players that can become complementary.

System Lock-In can be achieved either by "owning" unique or constrained distribution channels that locks-out competitors (e.g., optimal shelf space in a grocery store, or the best location was a small town) or developing an extensive set of complementary that supports your product or service and locks-in your customer (e.g., by appropriating the industry standard or dominant exchange). Further, mass adoption of the product should in itself significantly expand the value of the product to the customer creating a self-reinforcing feedback loop.

Conceptual frame work

Different scholars define conceptual framework according to the subject under review but all point to the same of methodology or maps of processes and procedures followed in solving a problem. This study adopts the following conceptual framework derived from the objectives of the study. The independent variables of the study are technology advancement, product classification,

customer segmentation and brand benefits, while the dependent variable will be customer satisfaction.

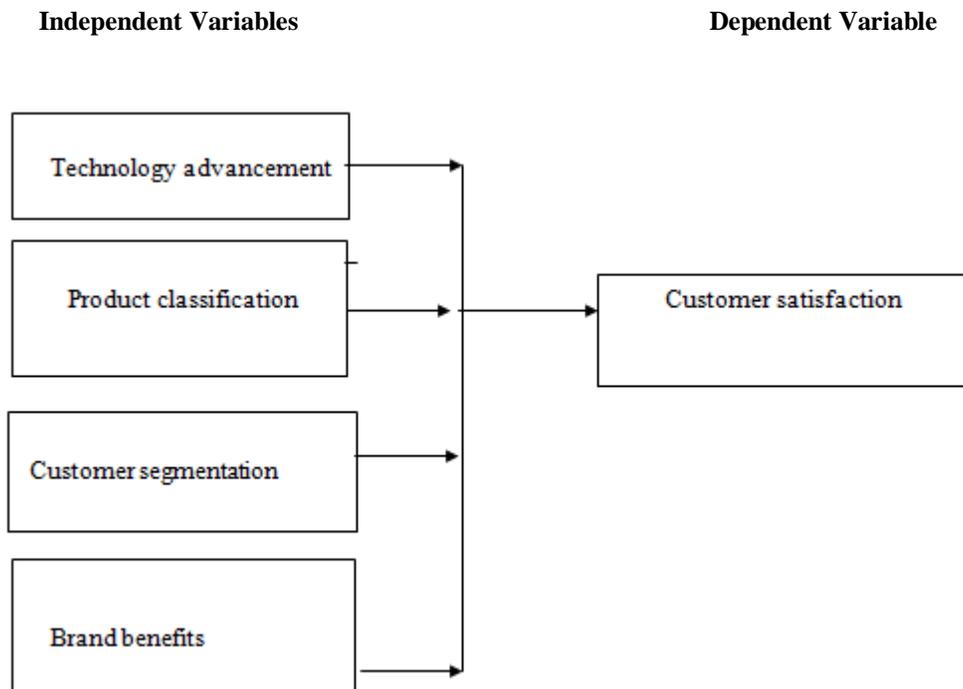


Figure 3. The conceptual framework (Source researcher 2014)

2.3.1 Technology advancement

Massive, rapid, technological innovations (Norton, 1995) are replacing the traditional branch teller. With greater competition brought by deregulation, globalization and widespread mergers and acquisitions taking place in the banking sector, more branches were being closed down and replaced by self-served banking (SSB) facilities like the ATMs, mobile and internet banking as part of a larger rationalization exercise. This enables them to dynamically plan new locations, evaluate their performance, forecast customers' attitude to new offered products and services, estimate clients' switching behavior, and finally provide marketing support to their geographically separate branches. The banking sector had been the backbone of every country. It implements and brings about economic reforms. Any change in this sector through technology has a sweeping impact on any country.

Product classification

Product classifications help marketers focus their efforts using consumers' buying behavior. A business can use these buying habits to design your marketing efforts for a clearly defined target audience. Consumer products are often classified as convenience goods, shopping goods, specialty products or unsought goods. Although these classifications are named as types of products, focusing on how your customers buy these goods were equally important as you classify products and develop your marketing campaigns (Howard, John A. 1977, Hoyer, Wayne and Steven, 1990).

2.3.3 Customer segmentation

The process of splitting customers, or potential customers, in a market into different groups, or segments, within which customers share a similar level of interest in the same or comparable set of needs satisfied by a distinct marketing

propositions. Marketing proposition, the 'tools' or means available to the organization to improve the match between benefits sought by customers and those offered by the organization so as to obtain a differential advantage. Often referred to as the four Ps, this is usually the appropriate mix of product features, price, promotion and place (service and distribution). For the customer, this manifests itself as benefits, cost, relevant image and convenience; in other words, a customer value proposition.

Customers segment themselves and take no notice of how companies segment their market(s). When choosing between competing products and services, customers select the proposition that meets their needs better than any other. To win market share, therefore, a company must ensure that their offers meet these needs better than any other at a price they perceive as providing superior value for money (which does not necessarily mean it has to be the cheapest). As this was how customers operate in a market, then a segmentation project should have these as its segmentation criteria.

2.3.4 Brand benefits

According to Marcia Yudkin branding was the process of creating distinctive and durable perceptions in the minds of consumers. A brand was a persistent, unique business identity intertwined with associations of personality, quality, origin, liking and more. Here's why the effort to brand your company or yourself pays off. Memorability; a brand serves as a convenient container for a reputation and good will. It's hard for customers to go back to "that what's its name store" or to refer business to "the plumber from the Yellow Pages." In addition to an effective company name, it helps when people have material reminders reinforcing the identity of companies they will want to do repeat

business with: refrigerator magnets, tote bags, datebooks, coasters, key rings, first aid kits.

2.3 Critique existing literature

Previous researchers have demonstrated the importance of increasing understanding of strategies to resolve customer complaints and more to study the behavior of customers, namely quality of life & sex (Ndubisi, 2005). Study customer behavior through the CM model to take the complaint as an opportunity to provide solutions, research studies and the (Vos & Huitema, 2008). As the study by (Baptista, 2003) in which an organization should attempt to resolve complaints informally, taken orally and should make proper records and the complaint should be resolved as soon as possible so the problem does not persist.

They have also emphasized differences in complaints against the Service Counter and self service terminals & (Vihtkari Snellman, 2003), was the nation that the use of self-service terminals in the bank to reduce customer complaints, but rather a circumstance where there is 40 per cent of users are not satisfied with the self-service. Researchers previously expressed understanding of customer dissatisfaction was the key to successful implementation of TQM and principals as well as the (Puga Leal & Pereira, 2002). Researchers say previous satisfaction is waiting to be served a major contributor to quality of service satisfaction (Sulek & Hensley, 2007).

Researchers previously expressed satisfaction with the care, satisfaction, trust and satisfaction as a control, each dependent on each other that Beverland, and 2005. Previous researchers to state that organizations need to keep employees as customers and keeping customers as employees of (Bowers & Martin, 2004). Researchers found that the quality of a product and services was dependent on the existing knowledge in the management. (Yang, 2006). Researchers say there was a strong relationship between the dimensions of service quality, performance and customer satisfaction. Previous studies were identified the benefits that customer retention delivers to an organization (see Colgate et al., 1996; Reichheld and Sasser, 1990; Storbacka et al., 1994). For example, the longer a customer stays with an organization the more utility the customer generates (Reichheld and Sasser, 1990). This was an outcome of a number of factors relating to the time the customer spends with the organization. These include the higher initial costs of introducing and attracting a new customer, increases in both the value and number of purchases, the customer's better understanding of the organization, and positive word-of-mouth promotion.

Customer satisfaction has been said one of the most widely used study in marketing. The previous research has tries to identify a number of variables of customer satisfaction. Because satisfaction was basically a psychological state, care should be taken in the effort of quantitative measurement, although a large quantity of research in this area was recently been developed. Work done by Berry (Bart Allen and Brodeur between 1990 and 1998) defined ten 'Quality Values' which influence satisfaction behavior, further expanded by (Berry ,2002) and known as the ten domains of satisfaction. These ten domains of satisfaction include: Quality, Value, Timeliness, Efficiency, Ease of Access, Environment, Inter-departmental Teamwork, Front line Service Behaviors, Commitment to the Customer and Innovation.

These factors are emphasized for continuous improvement and organizational change measurement and are most often utilized to develop the architecture for satisfaction measurement as an integrated model. Work done by Parasuraman, Zeithaml and Berry (Leonard L) between 1985 and 1988 provides the basis for the measurement of customer satisfaction with a service by using the gap between the customer's expectation of performance and their perceived experience of performance.

This provides the measurer with a satisfaction "gap" which was objective and quantitative in nature. Work done by Cronin and Taylor propose the "confirmation/disconfirmation" theory of combining the "gap" described by Parasuraman, Zeithaml and Berry as two different measures (perception and expectation of performance) into a single measurement of performance according to expectation. According to Garbrand, customer satisfaction equals perception of performance divided by expectation of performance. The usual measures of customer satisfaction involve a study with a set of statements using a Likert scale. The customer is asked to evaluate each statement and in term of their perception and expectation of performance of the organization being measured. Based on their responses, customers can be categorized into one of three groups: Promoters, Passives, and Detractors.

III. METHODOLOGY

Research design

The researcher used descriptive survey design method. This method was preferred because it allows for prudent comparison of the research findings. A descriptive survey was used to ensure complete description of a situation making sure that there was minimum bias in the collection of data thus reducing error in interpreting data. (Cooper, and Schindler, 2003, Burns and Grove ,2003, Polit, 2001, Parahoo, 1997).

3.2 Population

In this study the population was Fina bank staffs and their daily customers, who were grouped in terms of their age, educational status, socio-economic status and residential areas and 250 but out of 250 , 67 respondents took part in the research.

Departments	Frequency	Percentage
Top management staffs	20	8
Middle level staffs	50	20
Operational staffs	80	32
Customers	100	40
Total	250	100

Table 3.1: Target Population

3.4 Sampling and sample size

Ngechu (2004) underscores the importance of selecting a representative sample through making a sampling frame. A sample size of 10 Fina banks limited branches e.g. town centre branch opposite KPLC building partnerships managers of the

project implementation team was selected in the study out of the entire product positioning in all Fina banks within Kenya. Stratified proportionate random sampling technique was used to select the sample. According to Babbie (2010) stratified proportionate random sampling technique produce estimates of overall population parameters with greater precision and ensures a more representative sample was derived from a relatively homogeneous population. Stratification aims to reduce standard error by providing some control over variance. From each stratum the study will use simple random sampling to select respondents by taking 30% of each category. Statistically, in order for generalization to take place, a sample of at least 30 elements (respondents) must exist (*Cooper and Schindler, 2003*). *Mugenda and Mugenda (2003)* argue that if well chosen, samples of about 10% of a population can often give good reliability. The selection was as follows:

Table 3. 2: Sample Size

Departments and customers	Frequency	Sample Ratio	Sample
Top management staff	20	0.3	17
Middle level staff	50	0.3	19
Operational staff	80	0.3	21
Customer	100	0.3	10
Total	250		67

Source: Author (2012)

3.5 Data collection

According to *Sarantakos (1993)*, the successful completion of a sampling procedure connects the research with the respondent and specifies the kind and number of respondents who were involved.

The investigator knows at this stage not only what was to be studied, but also who to approach for the required information. The information was to be available, provided that the right ‘connection’ between the researcher and the respondents are made. This connection was made through the methods of data collection.

According to *Sotirios Sarantakos (2005)*, a questionnaire was a method of survey data collection in which information was gathered through oral or written questionnaires. Oral questioning was known as interviewing; written questioning was

accomplished through questionnaires which are administered to the respondents by mail or handed to them personally by the researcher.

Structured questionnaires were used in the collection of primary data and this was either self administered or face to face interview with the respondent. For self-administered questionnaires, the researcher further interviewed the respondents on a few responses that required further clarification.

3.6 Data collection procedure

The researcher recorded questionnaires as issued to the respondents i.e. identified sample and indicated timeframe within which the questionnaires had to be returned. Observations and interviews were recorded naturally.

3.7 Data processing and analysis techniques

Data was analysed using both descriptive and inferential statistics. The Statistical Package for Social Sciences (SPSS V21) is favored because of the quantitative nature of the data was used in the data analysis. These descriptive statistical tools were helpful to the researcher to describe the data and the features of data that is of interest. The study findings are presented using tables, histograms, bar charts and pie charts. Tables were used to summarise respondents for further analysis and facilitate comparison. In addition the study the researcher had used Karl Pearson’s product moment correlation analysis to assess the relationship between the variables. This was because correlation analysis illustrates both the direction and strength of the relationship between two variables (*Malhotra and Peterson, 2006*).

IV. RESEARCH FINDINGS AND DISCUSSION

Rates of response

The study had initially targeted 67 respondents, 50 respondents filled and returned their questionnaires thus constituting 75% response rate, while 17 of the respondents didn’t respond and never returned the questionnaires and constituted 25% non response rate. This collaborates *Bailey (2000)* assertion that a response rate of 50% is adequate, while a response rate greater than 70% is very good. This implies that based on this assertion; the response rate in this case of 75% was very good for a new study and facilitated collection of data on variability perspective of the different respondents of the Fina bank as it is shown in the figure 4.1 below.

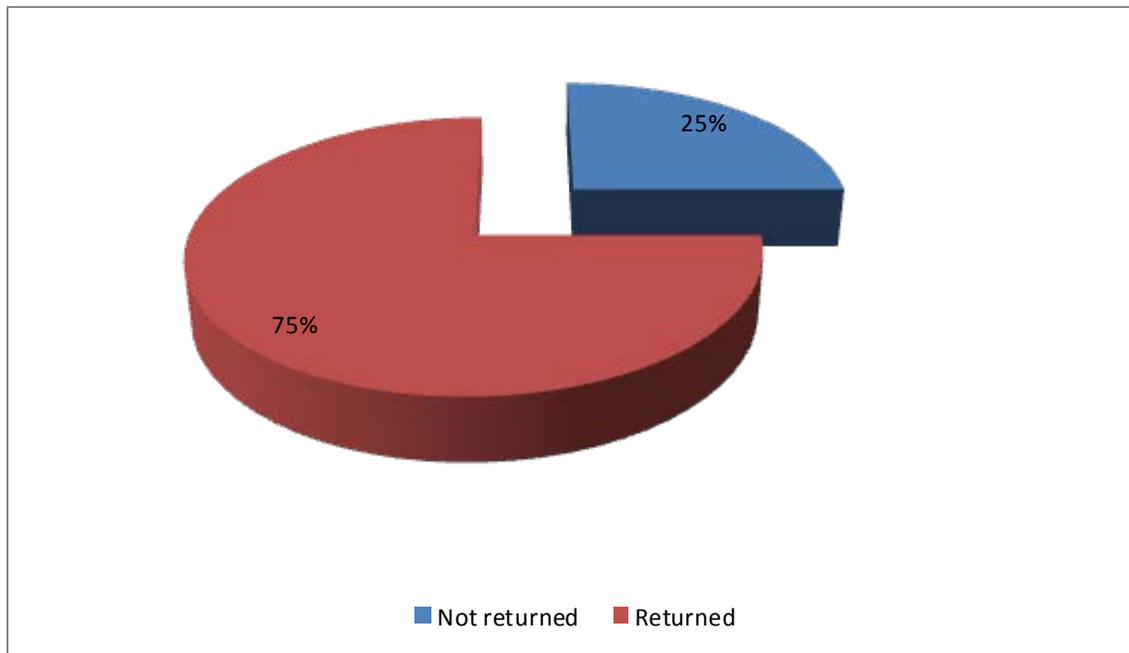


Figure 4.1 rate of respondents

Working experience	Frequency	Percent
1-5 years	25	50
5-10 years	15	30
10-15 years	10	20
Total	50	100

Table 4.1 Working experience of the respondents

The research sought to find out the number of years the respondents had been working at Fina bank. According to the study, 50% of the respondents had been working at Fina bank in department for a period between 1-5 years, 30% of the respondents for 5-10 years, 10% of the respondents had been working for 10-15 years which indicating that majority of the employees were new in the organization having worked for less than 10years but a facilitation of adequate experience since they account for more than half of the total sample group of the study. The variation in different years worked by different respondents helped the study in that information and data required was collected from different perspectives in terms of years with those who had been there for long giving the genesis of strategic positioning of service delivery and what factors were attributed to implement the strategy and how to deal with any challenges that may be encountered with the new employees giving out information from a recent perspective of modernity and changes

in infrastructure development, policies and legal frameworks of strategic positioning of service delivery at Fina bank thus viability and hence efficiency of data.

4.2 Demographic characteristics of the respondents

The establishment of demographic data of the respondents was guided by questions regarding the general information about them and the company in general. The data also establishes to what extend the respondents agree that the external environment has an influence on the strategic positioning of service delivery at Fina Bank. Majority of the respondents (75 percent) possess return the educational qualification higher than diploma or its equivalent and about 25 percent of the respondents are in the rank of senior manager and above. This is an indication that the respondents are highly rated employees who should know more about the strategic positioning of service delivery.

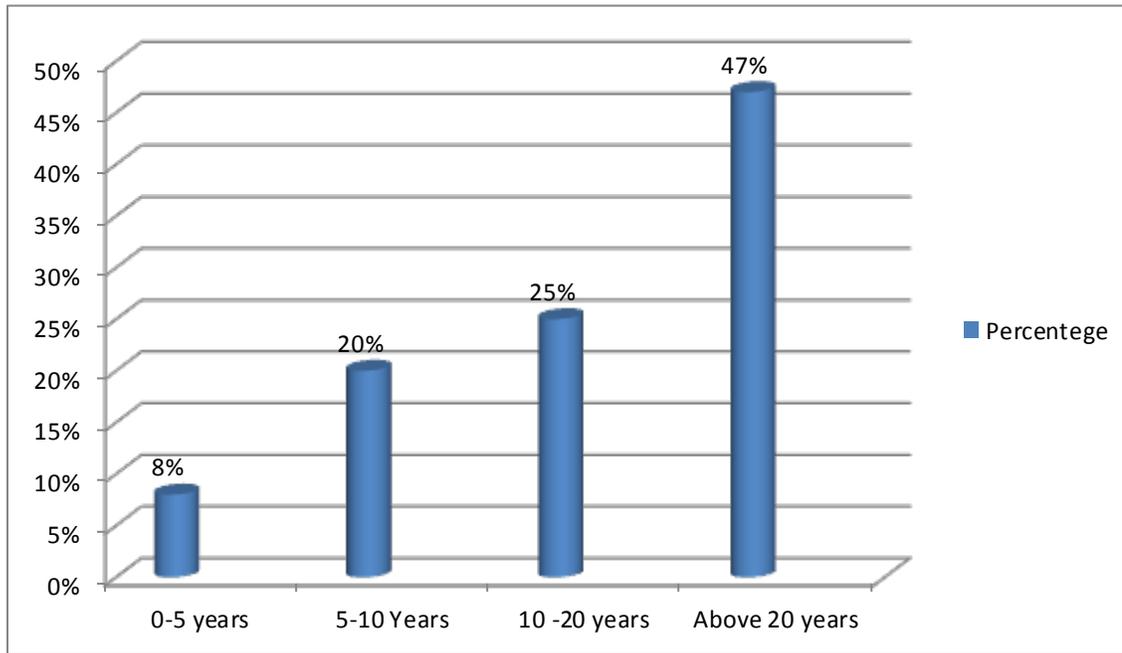


Figure 4.2 The period that the Organization has been in to existence

From the chart above its shows clearly that majority of the respondents which is 47% responded that the firm has been to existence for more than 20 years of operation, as 25% of the respondents said that the firm has been in to existence between

10-20 years while 20% of the respondents said the firm has been in its operation between last 5-10years and final 8% of the respondents said that the firm has been to existence between last 0-5years.

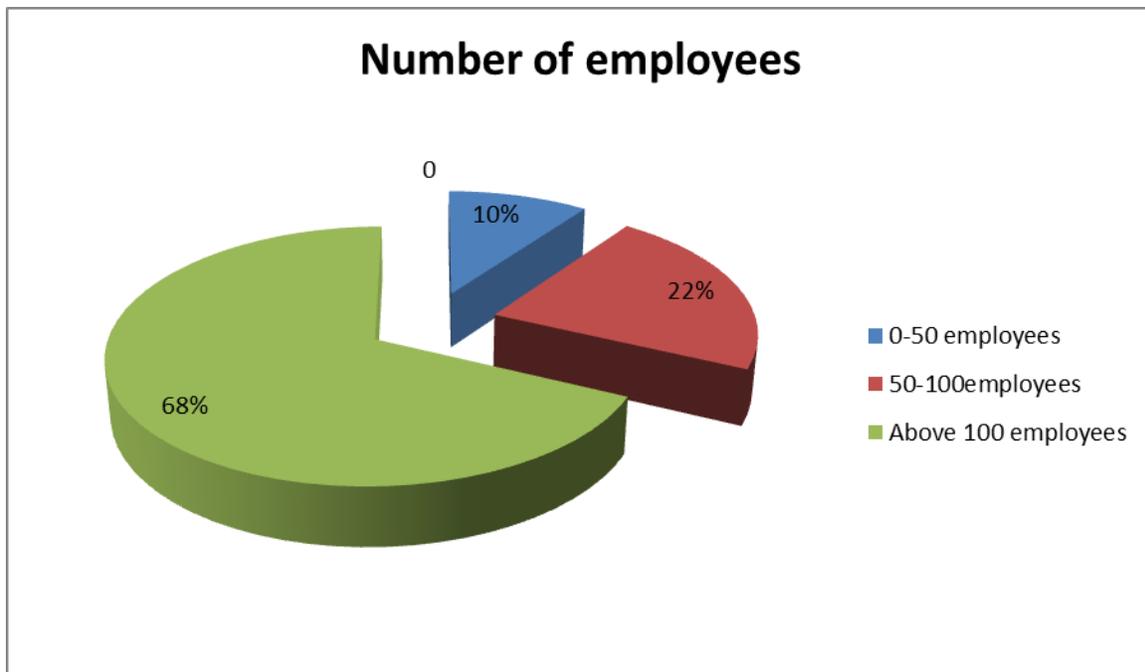


Figure 4.3 Total number of employees in your Organization

Based on the number of employees of the Fina bank has been analyze, 68% of the respondents said that majority of the employees in Fina bank range from 100 peoples under above as 22% of the respondents said the employees range from 50-100

employees and final 10% of the respondents said they range from 0-50 employees.

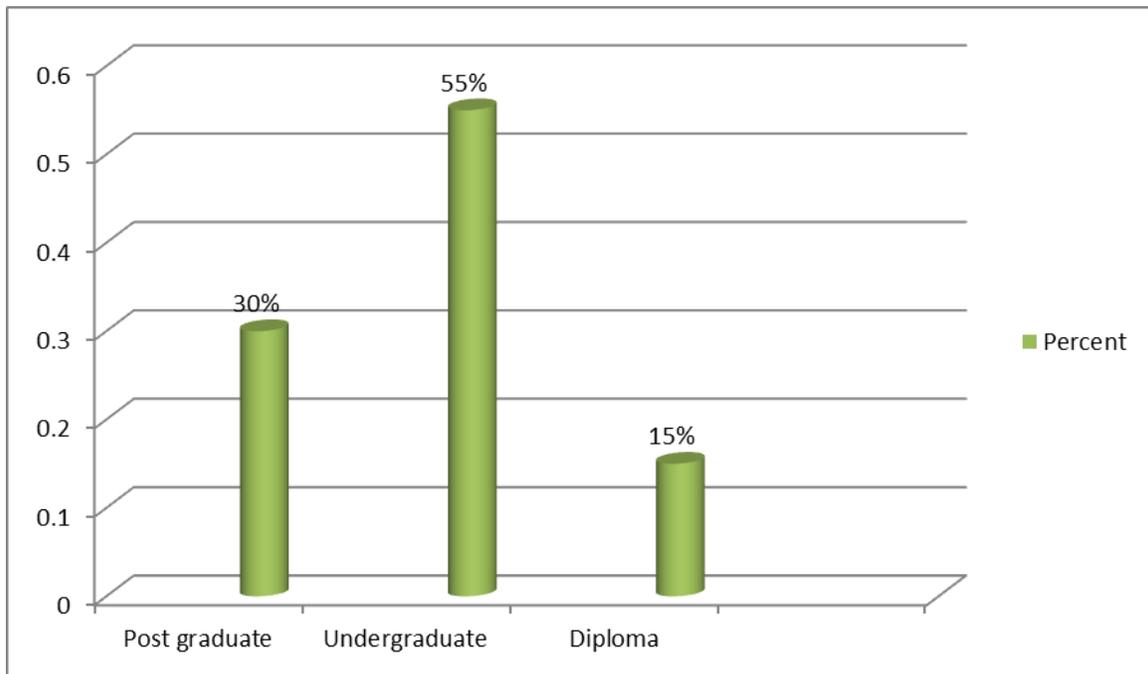


Figure 4.4 Level of education of the Fina bank Employees

Highest Level of Education

Regarding the highest level of education, that the respondent had achieved, 55% had reached undergraduate level, 15% of the respondents had reached diploma level and 30% had post graduate degrees this indicating a well educated employee bracket with the highest number being atleast under graduates thus professionalism of Fina bank and an implication of proper

structures and requirement for recruiting and employment by the organization, its highest level being post graduate holders is also a noble venture of having highly skilled employees in the banking industry hence enable to facilitate proper and efficient service delivery to customers and hence facilitate success of product or service branding.

Objective 4.3.1 Technology influence on successful customer satisfaction in Fina bank

Strategies	Strongly agree	Agree	Not sure	Disagree	Strongly disagree	Mean	Stdvn
New technologies can be very exciting for a project particularly if the technology enables the customer to do things that are otherwise not possible.	15	8	2	5	7	7.4	4.8
It is always safe to avoid the temptation to use technology whose success is in doubt.	7	10	5	9	8	7.8	1.9
Even if the technology has been proven successful, contractors and management must ensure that people working with this technology have attained adequate experience.	10	13	11	3	5	8.4	4.2
There is absolute need to test the technology always until one is comfortable it is going to work.	20	10	4	8	6	9.6	6.2
People working with technology should be skilled.	13	10	10	8	0	8.2	4.9

Table 4.3 Technology in influence successful customer satisfaction

According to the study findings on the table 4.3, the respondents strongly agreed that there is absolute need to test the technology always until one is comfortable of it, is going to work which is shown by a mean of 9.6 and standard deviation of 6.2. This shows that for a service to be effective out of knowledge one must test it if it will serve the purpose for which it was invested to enhance customer satisfaction.

More so, the respondents agreed that if the technology has been proven successful, contractors and management must ensure that people working with this technology have adequate knowledge and experience as customer satisfaction is a series of process. This indicates that successful of a technology must be proven by professionals and people that will work with the technology must be well skilled which is shown by a mean of 8.4 and standard deviation of 4.2.

As proposed in a standard deviation 4.9 and shown by mean 8.2 the respondents, had also strongly agreed that people working with technology should be skilled as it is ranked number three. This indicate that for a successful implementation of the technology in improving service delivery to enhance customer satisfaction it should managed and controlled by competent and well skilled personnel. Furthermore, the respondents agreed that it is always safe to avoid the temptation to use technology whose success is in doubt shown by a mean of 7.8 and a standard deviation of 1.9. This shows safety of the technology to be used for enhancing service delivery should be assessed before it is used to avoid the doubt of it. From the above table, a mean of 7.4 which also a stranded deviation of 4.8 shows that the respondents agreed that new technologies can be very exciting for a service particularly if the technology enables the customer to do things that are otherwise not possible.

4.3.2 Strategies that will enable product classification and enhance customer satisfaction at fina bank

Strategies	Strongly agree	Agree	Not sure	Disagree	Strongly disagree	Mean	Stdev
Product classifications are correlated with effective services delivery and customer satisfaction.	13	10	2	5	8	7.6	4.27
Companies that provide services are concerned about customer loyalty and goodwill to improve their performance, and customer satisfaction.	11	9	5	12	0	7.4	4.8
Companies that experience a high rate of competition in the market need to have marketing strategies that will enable their mission of exploiting the market through products classification and customer satisfaction.	8	18	10	10	4	10	5.09
The strategies used in managing customers segmentation are adhered with marketing ethical code in satisfaction of customer needs	15	12	1	5	2	7	6.20
Segmentation of customer plays a role of long term and adaptive relationship between customer and firm.	20	15	5	6	4	10	7.10

Table 4.4 Strategies that will enable product classification

The study sought to find out from the above table 4.4, as shown by mean 7.6 and standard deviation 4.27 shows that the respondents strongly agreed that product classifications are correlated with effective services delivery and customer satisfaction, this indicates that classification of the products and services has no boundary with customer satisfaction whenever service delivery is effective. The respondents also strongly agreed that companies that provide services are concerned about customer loyalty and goodwill to improve their performance, and customer satisfaction as shown by mean 7.4 with a standard deviation of 4.8. This implies that customer loyalty and goodwill has a role in determine the position of the firm performance as well as customer satisfaction.

From mean of 10 as shown in the table above the respondents agreed that companies that experience a high rate of competition in the market need to have marketing strategies that will enable their mission of exploiting the market through

products classification and customer satisfaction. This implies that competition stimulate firms to adopt it new strategies that will enable their goals to be realized and archive through meeting customer needs.

Respondents strongly agreed that the strategies used in managing customer’s segmentation are adhered with marketing ethical code, and in satisfaction of customer needs as shown by mean 7. This indicates that the strategies used must be in line with the marketing policies and ethical conducts as to determine the effectiveness of the products and the quality of services delivery to customer. In addition to the above findings, the majority of respondents agreed that segmentation of customer plays a role of long term and adaptive relationship between customer and firm as shown by mean 10 and a standard deviation of 7.10, this shows that customer segmentation plays a role in establishing and maintaining a long term relationship between the customer and the company.

4.3.3 Enhancing customer segmentation strategy to enhance customer satisfaction at Fina bank

Strategies	Strongly agree	Agree	Not sure	Disagree	Strongly disagree	Mean	Stdev
New strategy of customer segmentation based on technology advancement can be very exciting for influencing customer satisfaction.	14	5	7	6	10	8.4	3.64
It is always good to segment your customer based on economic advantages that will influence their satisfaction.	16	10	6	9	5	9.2	4.32
Even if customer segmentation has been proven successful as one of the marketing strategy, management must ensure that people working with this strategy have attained adequate experience to influence customer satisfaction.	28	10	2	3	6	9.8	10.63

Table 4.5 Enhancing customer segmentation strategy to enhance customer satisfaction at Fina bank

From the table 4.5 above as shown by mean 9.8 and a standard deviation of 10.63, the respondents strongly agreed that customer segmentation has been proven successful as one of the marketing strategy, management must ensure that people working with this strategy have attained adequate experience to influence customer satisfaction, this shows that management must put consideration on peoples who are working with marketing department to have the required qualification so as to influence customer satisfaction.

From the above findings as shown by mean 9.2 and a standard deviation of 4.32, the respondents strongly disagreed that it is always good to segment customer based on economic advantages that will influence their satisfaction). This implies that segmentation plays a great role in improving customer satisfaction however; the respondents strongly agreed that new strategy of customer segmentation based on technology advancement can be very exciting for influencing customer satisfaction as shown by mean 8.4.

4.3.4 Brand benefit at Fina bank

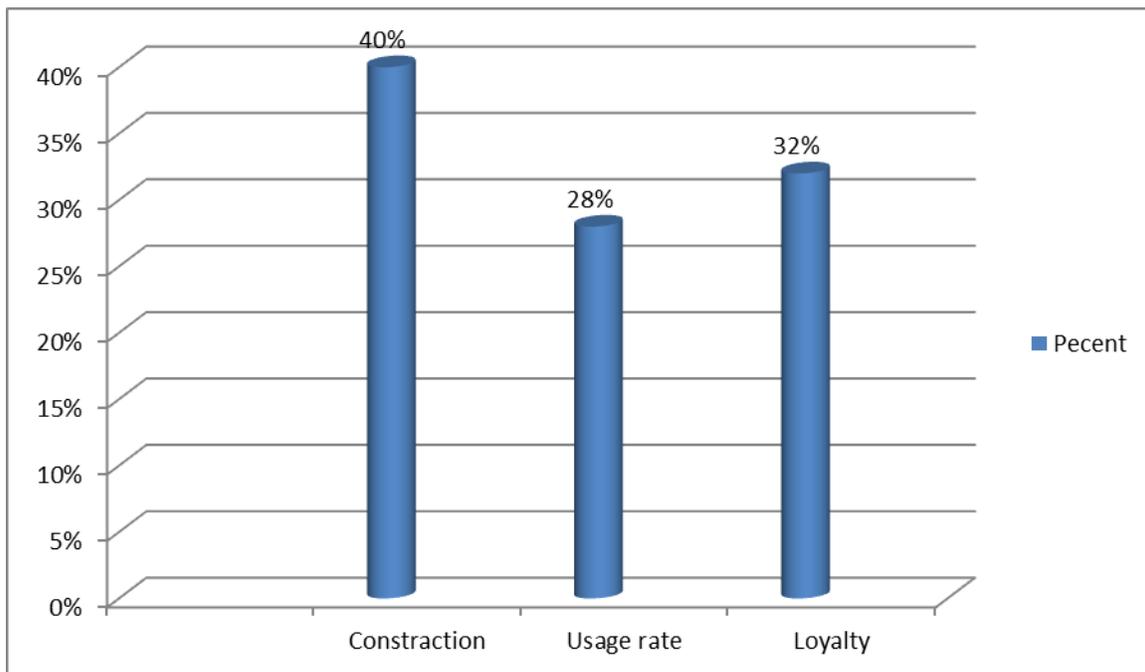


Figure 4.5 Brand benefit

The respondents also give their opinion as it is from the bar chart above its is clearly shown that for a product to be rebranded construction should be effective as the majority of the respondents suggested that which is shown by a 40% as 32% of the respondent felt that loyalty of customers towards the product is a major concerned that will assist project manager to have a

sound strategy in branding its products and services and final 28% of the respondents felt that usage rate must also be put in consideration as the frequently use of the product by the customer will either be changed when they see new brand of products and services or they may be more attracted to buy more of them.

4.3.5 Regression Analysis

Model	R	R Square	Adjusted Square	R	Std. Error of the Estimate	Change Statistics				
						R Square Change	F Change	df1	df2	Sig. Change
1	.652(a)	.425	.871		3.221	.0025	.0025	1	1	.915

Table 4.6: Model Summary

The adjusted R² is called the coefficient of determination. This value tells us how the success of strategic service delivery varied with effects of service delivery, information technology, product classification process, transparency in customer segmentation and accountability in conversing customers to the new brands of product and services. According to the above

table, the value of adjusted R² is 0.871. This implies that, there was a variation of 87.1 % of effects on the success of strategic positioning of service delivery at Fina bank due to service delivery, information technology, product classification process, transparency in customer segmentation and accountability when it comes to deliver service to customers.

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.431	3.125		1.725	.305
	Service delivery	0.374	.059	.098	.094	.935
	Information Technology	0.141	.048	.089	.091	.891
	Product segmentation process	0.354	.495	.094	.092	.912
	Transparency to customers segmentation and accountability in service delivery	0.426	.416	.097	.096	.953

Table 4. 7: Coefficient of Determination

As per the SPSS generated, the results established the below regression equation which was utilized: the regression equation. $Y = a + \beta_1(X_1) + \beta_2(X_2) + \beta_3(X_3) + \beta_4(X_4) + \hat{\epsilon}$. When $\beta_5=0$Equation 1

Where:-

Y = Success of strategic positioning of service delivery at Fina bank

A = constant

X1 = Service delivery

X2 = Information Technology

X3= Product classification process

X4= Transparency to customers segmentation and accountability in service delivery

Incorporating the values of the Beta values into equation 1 we have:

$$Y = 1.431 + 0.374 X_1 + 3.141 X_2 + 0.354 X_3 + 0.426 X_4$$

Equation 2: regression equation with beta values

The researcher conducted a multiple regression analysis and from the above regression model, the factors service delivery, information technology, Product classification process, transparency in customer segmentation and accountability in delivering service, have effects on the success of strategic positioning of service delivery at Fina bank to a level of 1.431. It was established that a unit increase in service delivery at Fina bank would cause an impact on the level of customer satisfaction at Fina bank by a factor of 0.374, a unit increase in information technology at Fina bank would cause an impact on strategic

position of service delivery by a factor of 3.141, also a unit increase the product classification process would cause an impact on strategic positioning of service delivery at Fina by a factor of 0.354. Also a unit increase in transparency to customer segmentation and accountability in service delivery would an impact on the success of strategic positioning of service delivery by a factor of 0.426. This shows that there is a positive relationship between success of strategic service delivery at Fina bank service delivery, information technology, and product classification process, transparency in customer segmentation and accountability in service delivery.

V. SUMMARY OF THE FINDINGS

5.2 Summary of findings

5.2.1 Technology advancement on customer satisfaction

It was discovered that technology advancement in enhancing good service delivery has a great significance. Customers would like to be served or to have a self-service system that will base on the technology advancement as it was seen that technology will be exiting if it will give a chance for the customers to do things that will be convenient to them for example the use of mobile phones to facilitate their banking activities and the use of ATMS. It was also found that this will be advantageous to a service firm to go hand in hand with technology, as many of the respondents had agreed that investment in new technology to improve service delivery to customers will have a great significance to the firm at large as it will put it at competitive stance in the banking industry.

5.2.2 Product classification on customer's satisfaction

From the findings and analysis the researcher had discovered that majority of the respondents had strongly agreed that for the firm to have a good service or products it needs to invest in research and development programs in order to have a clear picture of what their customer and market wants them to do.

From the study it was discovered that most firm services delivery are mostly conducting a thorough market research in indentifying their customer needs and wants and also in knowing their competitors are doing in maintaining their competitive advantage, it needs the firm to have in place good strategies of addressing the market whenever they are launching their product and service.

5.2.3 Consumer segmentation enhances customer satisfaction

It was discovered that for a market and customer segmentation to work effectively the firm must have clear strategies in enhancing the service delivery of their output to the market, mostly segmentation will depend on customer loyalty and the goodwill between the firm and their existing customers as this will enable positioning of the products and service depending on their consumption behavior.

It was also found that segmentation will be as a result of stiff competition that a firm needs to improve its activities or it needs to use other strategies that will enable them to exploit the market for their segmentation mission to succeed, under all this their activities need to adhere with the legal and marketing ethical codes that will enable the firm to establish a long lasting relationship with its customers.

5.2.4 Brand benefit

The researcher discovered that for a product brand to be effective and attractive a firm must invest in marketing research to know the buying behaviors of their potential customers that will assist the firm in knowing how to strategizing their construction for rebranding their products and service so as to satisfy the existing customers and if possible attracting new customers.

However if firm may consider all the aspects of rebranding well it will be in a better position to strategically offer effective products and services at affordable price which will lead to a firm to increase its cash inflows as well as improving their market share and final it will improve its competitive advantages over their competitors.

5.3 Conclusion

The personnel in the project management department at Fina bank needs to have well and competent staffs in undertaking a troughed marketing research to enable them to have a clear picture on how to invest in the technology that will be effective for them to enhance their mission of improving the strategic position of service delivery which will lead to customer satisfaction. The stakeholder in marketing, ICT and financial department need to coordinate well so as to avoid the conflict of interest as investing in new technology is expensive that they need a well defined strategy as technology keeps on changing frequently.

Finally, the study concludes that ICT Infrastructure affects implementation of quality technology which will facilitate the service to enhance the customer satisfaction, e-banking ,ATMS and other services offered by most banks in Kenya especial at Fina bank are affected largely by ICT infrastructure of Kenya this is one of the major draw backs that the stakeholders of Fina bank must put a lot of eye mark so as to have a sound strategies on how to come up with a good strategy to position their service delivery to satisfy their customer as well as improving their competitive advantages over their competitors.

5.4 Recommendation

From the findings and conclusions of this study the researcher recommend that strategic service delivery at Fina bank need to be well defined and strategically put in place in order to improve its cash inflows. These recommendations can also be adopted by the company so as to improve its sales performance in the market. The following are the recommendations to the management in order to improve its market share and its profits through customer satisfaction.

To conduct marketing research- for Fina bank limited to be able to continue increasing its market share and profits, marketing research must be thoroughly done regarding the technology to be adopted so as to improve the service delivery, and also to know and understand their market properly and also know the method their competitors use to market their products and the technology used in offering service to customers.

Fina bank limited should also understand its market and customers properly so that they may be able to deliver superior service through adopting unique marketing strategies (customer segmentation, product classification, price decisions) in launching their service and products to the market . This will help the company to minimize the cost of marketing which might

even lead to loss of customers and good will from existing customers.

Service delivery is very essential in any company. This is because; the management of any company can solicit business with other company or customers without having to go using sales people or customer care service which is somehow tiresome compared to online feedback, e-banking and ATMs services. In light of this, I would recommend that the Fina bank limited selects and train personnel which will be able to implement this method of strategic service positioning fully because the researcher have discovered that the strategy is very advantageous and can lead to increase of profits in the company. The companies also need to include its customers so that they may be able to know exactly what they need and this will lead to reduction of costs which might be caused by the poor marketing of the product and services.

5.5 Suggestion to further studies

Further studies can be carried out on the effects of strategic positioning of the product/service to enhancing customer satisfaction on the performance of the organization. These studies can be carried out in many firms to assess the effects of strategic product positing. Since the study only cased studied fina bank ltd. A survey on all commercial banks would be an effective research.

REFERENCES

- [1] American Marketing Association Dictionary. Retrieved 2011-07-09. The Marketing Accountability Standards Board (MASB) endorses this definition as part of its ongoing Common Language: Marketing Activities and Metrics Project.
- [2] Alden, Steenkamp, & Batra, (1999), journal of business strategy vol.13
- [3] Aaker, D.,V. Kumar, and G. Day. (2003), Marketing research. 800 p. 7th ed., John Wiley and Sons, New York, USA.
- [4] Ainscough, T.L., & Lockett, M.G. (1996), The internet for the rest of us: marketing on the World Wide Web.
- [5] Allen, F., McAndrews, J., & Strahan, P. (2001), E-finance: An Introduction, Working Paper No. 01-36. Financial Management and Policy, New Delhi. India.
- [6] Anderson, E.W., & Sullivan, M.W. (1993), The antecedents and consequences of customer satisfaction for firms.
- [7] Andreassen, T.W. (1999), What drives customer loyalty with complaint resolution? Journal of Service Research, 1, (4), 324-32
- [8] Bansal, H., & Voyer, P. (2000), Word-of-Mouth Processes Within a Service Purchase Decision Context. Journal of Service Research, 3, (2), 166-77.
- [9] Black, N.J., Lockett, A., Winklhofer, H., & Ennew, C. (2001), The adoption of Internet financial services: A qualitative study. International Journal of Retail & Distribution Management, 29(8), 390-398.
- [10] Broerick, A Vachirapornpuk, S. (2002), Service quality in Internet banking: the importance of customer role. Marketing Intelligence & Planning, 20, (6), 327 – 335.
- [11] Buchanan, Leigh (1 March 2011), "A Customer Service Makeover". Inc. magazine. Retrieved 29 Oct 2012.
- [12] Central Bank of Jordan. (2009), Annual Report,
- [13] Daniel, E. (1999), Provision of electronic banking in the UK and the Republic of Ireland. International Journal of Bank Marketing, 17(2), 72-82.
- [14] Devlin, J.F. (1995), Technology and innovation in retail banking distribution. International Journal of Bank Marketing, 13, (4), 19-25.
- [15] DeYoung, R. (2001), The financial performance of pure play Internet banks. Economic Perspectives, 25, (1), 60-75.
- [16] Dick, Alan S. and Kunal Basu (1994), "Customer Loyalty: Toward an Integrated Conceptual Framework," Journal of the Academy of Marketing Science, 22 (2), 99-113.
- [17] Doll, W.J., & Torkzadeh, G. (1988), The measurement of end-user computing satisfaction. MIS Quarterly, 12, (2), 259-74.
- [18] Farris, Paul W.; Neil T. Bendle; Phillip E. Pfeifer; David J. Reibstein (2010), Marketing Metrics: The Definitive Guide to Measuring Marketing Performance. Upper Saddle River, New Jersey: Pearson Education, Inc. ISBN 0-13-705829-2.
- [19] Hoyer, Wayne D. (1984), "An Examination of Consumer Decision Making for a Common Repeat-Purchase Product," Journal of Consumer Research, 11 (December), 822-829.
- [20] Hoyer, Wayne D. and Steven P. Brown (1990), "Effects of Brand Awareness on Choice for a Common, Repeat-Purchase Product," Journal of Consumer Research, 17 (September), 141-148.
- [21] Howard, John A. (1977), Consumer Behavior: Application of Theory, New York: McGraw Hill.
- [22] Howard, John A. (1983), "A Marketing Theory of the Firm," Journal of Marketing, 47 (Fall), 90- 100.
- [23] Johnson, Michael D. (1998), Customer Orientation and Market Action, Upper Saddle River, NJ: Prentice Hall.
- [24] Johnson, Michael D. and Andreas Herrmann (1996), "Noncomparables Compared: Customer Satisfaction across Industries and Countries," in Christine Roland-LTvy (ed.), Social & Economic Representations: Tome I, Paris, France: UniversitT RenT Descartes, pp. 332- 341.
- [25] Jones, Thomas O. and W. Earl Sasser, Jr. (1995), "Why Satisfied Customers Defect," Harvard Business Review, November-December, 88-99
- [26] Jones, Michael A., David L. Mothersbaugh, and Sharon E. Beatty (2002), "Why Customers Stay: Measuring the Underlying Dimensions of Services Switching Costs and Managing.
- [27] Krishnaveni and Divya Prava, (2004), journal on Rising standards of service. 27 26-34
- [28] Philip Kotler and Gary Armstrong (2008) principles of marketing edition of twelfth low price edition
- [29] Katona, George (1980), Essays on Behavioral Economics, Ann Arbor: University of Michigan, Institute for Social Research.
- [30] (Lovelock et al 1996), International and globalization, The free press New york.
- [31] Lehmann, Donald R., William L. Moore and Terry Elrod (1982), "The Development of Distinct Choice Process Segments over Time: A Stochastic Modeling Approach," Journal of Marketing, 46 (Spring), 48-59
- [32] Leong, Siew Meng (1993), "Consumer Decision Making for Common, Repeat-Purchase Products: A Dual Replication," Journal of Consumer Psychology, 2 (2), 193-208.
- [33] Lewicki, Roy J. and Barbara Benedict Bunker (1996), "Developing and Maintaining Trust in Work Relationships," in Roderick M. Kramer and Tom R. Tyler (eds.), Trust in Organizations: Olshavsky, Richard W. and Donald H. Granbois (1979), "Consumer Decision Making-Fact or Fiction?," Journal of Consumer Research, 6 (September), 93-100.
- [34] Punniyamoorthy, M and Prasanna Mohan Raj, "An empirical model for brand loyalty measurement", Journal of Targeting, Measurement and Analysis for Marketing, Volume 15, Number 4, September 2007 , pp. 222-233(12)
- [35] Reichheld, Frederick F. (1996), "Learning From Customer Defections," Harvard Business Review, March-April, 1996, 55-69.
- [36] Reichheld, Frederick F. and W. Earl Jr. Sasser (1990), "Zero Defections: Quality Comes to Services," Harvard Business Review (September-October), 105-11
- [37] Reichheld, Frederick F. (1993), "Loyalty-Based Management," Harvard Business Review, 71 (2), 64-73.
- [38] Sachdev & Verma, 2004, Trade-off between relationships and economies, trust and products, or service and efficiency.
- [39] Solomon, Micah (4 March 2010), "Seven Keys to Building Customer Loyalty--and Company Profits". Fast Company. Retrieved 29 Oct 2012.
- [40] Verena Veneeva, (2006), The Market Segmentation Company (UK) Limited.

AUTHORS

First Author – Asaph Ngetha Kamau, Transactions officer
Guaranty Trust Bank Mombasa-Branch, P.O Box 90089-80100,
Email: surfasaph@gmail.com

Second Author – Moses Kimani Wafula, Senior Assistant
Librarian Jomo Kenyatta University of Agriculture and
Technology Mombasa CBD, P.O Box 81310-80100, Mombasa,
Email: wafulak@jkuat.ac.ke

Antioxidative and antimicrobial activities of different solvent extracts of *Moringa oleifera*: an *in vitro* evaluation

Esayas Welday Tekle^{1,2}, N. P. Sahu¹, Makesh M.³

¹ Fish Nutrition, Biochemistry and Physiology Division, Central Institute of Fisheries Education, Mumbai-India

² College of Marine Sciences and Technology, Massawa, Eritrea

³ Aquatic Environment and Health Management Division, Central Institute of Fisheries Education, Mumbai-India

Abstract- Aqueous, methanolic (80%) and ethanolic (70%) extracts of the leaves, flower, stem bark and pod/fruit (denoted as AL, AF, AB, AP, ML, MF, MB, MP, EL, EF, EB and EP for aqueous leaf, aqueous flower, aqueous bark, aqueous pod, methanolic leaf, methanolic flower, methanolic bark, methanolic pod, ethanolic leaf, ethanolic flower, ethanolic bark and ethanolic pod extracts, respectively) of *Moringa oleifera* were evaluated for their antioxidative activities and antimicrobial properties. 2,2-Diphenyl-1-picryl hydrazyl (DPPH) radical scavenging activity (%), total phenolic contents (TPC) and ferric reducing antioxidant power (FRAP) were used as a means of evaluating the *in vitro* anti-oxidative activities of the extracts. All the extracts showed a dose-dependent activity with each method. There was a significant positive correlation ($P < 0.01$) between DPPH values and TPC ($r^2 = 0.76$) as well as between TPC and FRAP value ($r^2 = 0.93$). With the DPPH and FRAP methods, EL and AB showed highest and lowest ($P < 0.05$) overall activity, respectively. Moreover, EL exhibited highest activity with all the three methods starting from the lowest concentrations. At the higher two concentrations (7.5 and 10 mg/ml), EF showed highest activity ($P < 0.05$) as compared to all the other extracts and a standard antioxidant, BHT. Anti-microbial activity of the extracts using the disc diffusion method and minimum inhibitory concentration (MIC) assay revealed that ethanolic extracts from all parts of moringa showed highest activity against *Aeromonas hydrophila* and *Micrococcus luteus* on concentration dependent manner than the aqueous extract counterpart. Although all the extracts exhibited considerable anti-oxidant activities with either one or both of the assays, EL and EF showed the best results and can be recommended as natural anti-oxidants in food/feed preparation and formulation.

Index Terms- antimicrobial property, antioxidative activity, DPPH, MIC, *Moringa oleifera*, total phenolic content,

I. INTRODUCTION

Reactive oxygen species (ROS) – commonly known as “free radicals” – such as superoxide ion (O_2^-), hydroxyl radical ($\cdot OH$), peroxy nitrite ($OONO^-$), hypochlorous acid (HOCl) etc. are generated in the body of animals in response to a number of stress factors, [1] The ROS can also be produced as the result of the respiratory burst of the cells in the mitochondria during the normal metabolic functioning of the body cells. Pertinent to these ROS, different cellular and extracellular components, primarily the nucleic acids, are damaged causing or enhancing a number of

degenerative and carcinogenic diseases [2] These ROS are primarily responsible for the occurrence of cardiovascular diseases (CVD), hypertension, anemia, diabetes, inflammation, liver disease, Alzheimer's, Parkinson's and HIV disease and also accelerate the aging process [3]. Synthetic antioxidants such as the butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) have been widely used (since 1947) as anti-oxidants and preservatives in the food industry as well in animal feed production (mainly aquafeeds) to alleviate the common occurrence of lipid peroxidation where fats, specifically unsaturated fatty acids, are in considerable composition in the food/feed item. However, synthetic antioxidants are suspected for their health impairments in animals and humans as well. Butylated hydroxytoluene (BHT) was identified as a lung tumor promoter by causing chronic inflammation in mice [4].

Plant and herbal extracts are considered to be powerful and healthy natural anti-oxidant and anti-microbial agents. The use of plant extracts as antioxidants to mitigate stress as well as to combat pathogenic microorganisms such as bacteria, virus, fungi and parasites are some of the latest advances in the nutrition and nutraceuticals research. Some co-authors in their previous study to evaluate the antioxidant and antimicrobial properties of ten Indian medicinal plant extracts found that all the plant extracts showed strong radical scavenging and reducing power as well as antimicrobial properties in a dose dependent manner, suggesting their use as nutraceuticals in the food/feed formulation [5]. Plant extracts act as antioxidants by scavenging and inactivating the damaging free radicals that are produced through normal cellular activity and from various stress factors [6]. It has been suggested that the antioxidant function of plant extracts which are rich in micronutrients could enhance immunity by preserving the functional and structural integrity of the immune cells [7]

Moringa oleifera Lam., commonly known as “drumstick tree”, “horseradish tree” or “ben oil tree” is the best known and widely distributed species of the Moringaceae family and is having an impressive range of medicinal uses apart from its high nutritional value. Native to Western and sub-Himalayan tracts, India, Pakistan, Asia and Africa, this plant is distributed throughout the world [8] because of its resistance to wide range of environmental conditions including arid and semiarid climatic zones with dry, sandy soils [9]. Almost every part of the plant – the roots, stem, the barks, leaves, branches, flower, fruit/pods, etc. are useable either by animals or humans, making it to be reputable as “the multipurpose tree”.

The roots, leaves, gum, flowers, and infusion of seeds have active chemical constituents such as nitrile, glycosides and

thiocarbamate glycosides, which are suggested to be responsible for the diuretic, cholesterol lowering, antilucer, hepatoprotective, and cardiovascular protective property [10]. The roots have been reported to possess antispasmodic activity through calcium channel blockade, which forms the basis for justifying its traditional use in diarrhoea treatment [11,12]. It also possesses antimicrobial activity due to its principle component pterygospermin. The leaves have been reported to be valuable source of both macro- and micronutrients, rich source of β -carotene, protein, vitamin C, calcium, and potassium and act as a good source of natural antioxidants; thus enhancing the shelf-life of fat-containing foods [13]. The fresh leaf juice was found to inhibit the growth of human pathogens such as *Staphylococcus aureus* and *Pseudomonas aeruginosa* [14,15]. The flowers showed effective hepatoprotective effect due to the presence of quercetin [16]. Methanolic fruit extract showed wide spectrum antimicrobial and antifungal activities when tested against eleven species of bacteria and one species of fungus with highest susceptibility against *Pseudomonas aeruginosa* as assayed by the disc diffusion method [17]. The seeds are also considered to be antipyretic, and for their acrid characteristics are reported to show antimicrobial activity [18].

Moringa contains specific plant pigments such as the carotenoids lutein, alpha-carotene and beta-carotene, xanthins and chlorophyll with demonstrated potent antioxidant properties; it is well known for other phytochemicals with known powerful antioxidant ability – kaempferol, quercetin, rutin and caffeoylquinic acids; powerful antioxidant vitamins – C, E, and A [13, 19]. The antioxidant activity of all the phytochemical components of the tree makes it an important nutritional component in the body's defences against free radical oxidative damage. Saalu and co-authors [20] concluded that leaf extract of *Moringa oleifera* has a modulating role on hydroxyurea-induced testicular toxicity in Sprague –Dawley rats which is caused due to oxidative stress.

Both water and ethanolic extracts of *M. oleifera* leaves have similar antioxidant activity (about 95% inhibition of peroxidation) to that of the well-known synthetic antioxidants, BHA and BHT and by far greater than that of vitamin C[21]. Several co-authors in their study observed that ethanolic extract of moringa fruit showed highest phenolic contents along with strong reducing power and free radical scavenging capacity. Besides, their results proved the potent antioxidant activity of aqueous and ethanolic extract of moringa which adds one more positive attribute to its known pharmacological properties and hence its use in traditional system of medicine [22]. In conclusion, the active principles from the different parts of the plant provide tremendous medicinal and health benefits for human as well as other animals including anti-inflammatory, antimicrobial, antioxidant, anticancer, cardiovascular, hepatoprotective, anti-ulcer, diuretic, antihelmintic, cholesterol lowering [23, 10], antiurolithiatic [24]and antispasmodic activity [12].

Although a number of research works have indicated the medicinal benefits of the extracts from the different parts of moringa, few or none of them made a comprehensive and comparative study of the extracts from the various parts of the plant. In the current study, *in vitro* antioxidant and antimicrobial activity assays of aqueous, methanolic and ethanolic extracts

from four different parts of *M. oleifera* (leaves, fruit, flower and bark) were carried out to evaluate the medicinal and health benefits of the plant.

II. MATERIALS AND METHODS

Collection of plant material

Leaves, flowers, fruit and stem bark of *Moringa oleifera* were collected from Kutmia area of the port city of Massawa, Eritrea. All the parts of the tree were collected fresh and allowed to air-dry in a shaded place thereafter were transported to the Central Institute of Fisheries Education, Mumbai, India for the required research work.

Preparation of plant extracts

Each plant material was blended into fine powder using an electrical grinder and passed through 60 mesh. Three solvents, namely aqueous (distilled water), 80% methanol and 70% ethanol were used for the extraction. Forty grams of the leaf, fruit and stem bark powder and 30 grams of the flower were weighed and transferred into four conical flasks of one liter. Eight hundred millilitre of each of the solvents was added to dissolve the dry powder of each plant material in the flasks. The aqueous dispersion was heated on a magnetic stirrer cum hotplate (SPINOT[®], Tarsons, India) at a temperature of 70°C for 1 hour. After allowing cooling down, the dispersion was filtered using a fine mesh cheese cloth and the residue was re-extracted in the similar manner using 200 ml distilled water. The methanolic and ethanolic dispersions of each part were divided into four 200 ml conical flasks and were set on a shaker (ORBITEK[®], Scigenics, India) at 160 rpm for 24 hrs. Dispersions were filter through cheese cloth and residues re-extracted using 200 ml of the respective solvent. All the filtrates were centrifuged (REMI-CPR24, Mumbai, India) at 5000 rpm and 4°C for 10 min. The supernatant was carefully collected into labeled bottles for each extract. The filtrates were concentrated using rotary evaporator (IKA[®] RV 10 basic) at a temperature of 40-65°C (depending on the boiling point of the solvents) and a rotor speed of 40 rpm. The remaining were collected and further concentrated to form a thick semi-solid (tar) using a water bath set at 70-80°C after which all extracts were properly labeled and kept at 4°C until use. Aliquots of known weight from each extract were freeze-dried for the estimation of yield on dry weight basis.

Determination of antioxidant activity

The antioxidant activity of the various extracts was evaluated through three antioxidant activity assays: 2,2-diphenyl-1-dipycryl hydrazyl (DPPH) radical scavenging assay, the ferric reducing antioxidant power (FRAP) assay and total phenolic contents (TPC).

DPPH radical scavenging activity

The DPPH assay was conducted following the methods adapted by previous researchers [25] with some modifications. Aliquots 30 μ l of each extract at concentrations 0.5-10mg/ml were pipetted and returned into test tubes set in triplicate for each sample. Two milliliter of 0.06mM DPPH in methanol was mixed diluting the extracts to a final concentration of 7.5-150 μ g/ml. The reaction mixture was incubated in a dark place for 30 min.

After 30 min incubation period, absorbance was measured at 515 nm using Shimadzu UV-1800 spectrophotometer. A blank reading was also taken using 2ml of DPPH without the extract. Ascorbic acid and butylated hydroxytoluene (BHT) were also used as positive controls for the comparison of the antioxidant activities. Each test was performed in triplicate and the percentage radical scavenging activity was calculated according to the following equation:

$$\text{Radical Scavenging (\%)} = (A_b - A_s)/A_b * 100$$

where A_b is the absorbance of the blank (DPPH in methanol) and A_s is the absorbance reading of the sample (extract) at 515nm.

Total Phenolic Contents (TPC)

The Folin Ciocalteu (FC) colorimetry method [26] with slight modifications was used to determine the total phenolic contents of the extracts. Briefly, 0.5 ml of Folin Ciocalteu reagent (FCR) was added into aliquot of the various extracts at various concentrations. After adding 7 ml of distilled water, the mixture was well vortexed and 1.5 ml, 20% Na_2CO_3 was added after 10 min of incubation period at room temperature. The mixture was heated in water bath at 40°C for 20 min. Absorbance readings at 765 nm were taken after cooling in ice. A blank with all the reagents but without the extracts was used as a reference for the absorbance readings. All tests were carried out in triplicates. A standard curve was established using gallic acid at concentrations 0.05-0.5 mg/ml and the total phenolic contents of the extracts was expressed as gallic acid equivalent (GAE) in mg/100g dry weight extract.

Ferric Reducing Antioxidant Power (FRAP)

Previously adopted method [22] with some modifications was followed to determine the FRAP for each extract. Aliquot (50 μ l) of the sample extracts (concentrations 0.5-10mg/ml) was mixed with 2ml FRAP reagent composed of 300mM acetate buffer (pH 3.6), 20 mM ferric chloride ($\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$) and 10 mM 2,3,6-tripycridyl-s-triazine (TPTZ) in 40 mM HCl in the ratio of 10:1:1. The mixture was warmed at 37°C in water bath for 10 min. Absorbance reading was taken at 593 nm. Ferrous sulphate, Fe(II) sulphate, standard curve was established by preparing aqueous solutions of known concentrations between 0.1-1.0 mM and mixing with the FRAP working solution. All samples were carried out in triplicates. FRAP was expressed in mM of extract as Fe(II)-sulphate equivalent.

Antimicrobial properties of Moringa extracts

The antimicrobial activity of the various extracts was tested using the disc diffusion method and minimum inhibitory concentration (MIC) determination.

Preparation of standard bacterial working suspension

Muller Hinton broth, 21g in 1000ml distilled water was prepared in a sterile condition. About 10ml of the broth was transferred into each of 3 centrifuge tubes. Following aseptic microbial techniques, a loop-full of pure culture of three bacterial species namely *Aeromonas hydrophila*, *Micrococcus luteus* and *Staphylococcus aureus* was inoculated into each of the prepared broth medium separately and the tubes were incubated in a

shaker-incubator at 37°C for 24 hrs. The bacterial suspensions with a visible turbidity were centrifuged at 4000 rpm, 4°C for 10 min. The supernatant was discarded and the bacterial pellets were washed using PBS and re-centrifuged following the same procedure. After discarding the supernatant, the pellets were dissolved in newly added PBS and the turbidity was adjusted to 1McFarland standard to obtain a bacterial suspension with an approximate density of 3×10^8 CFU/ml.

Disc diffusion method

This method assesses the antimicrobial activity of a bioactive compound by culturing bacteria in the presence of the compound and measuring the zone of inhibition which corresponds to the area where no bacterial growth is observed at an optimum bacterial growth conditions. The higher the diameter (zone of inhibition), the more the bacteria are susceptible to the bioactive compound/extract. The method was carried out according to previous works [27] with some modifications. Ninety millimeter sterile culture plates were used to prepare a Muller Hinton agar growth media. Aseptic techniques were followed to inoculate the test bacteria from the standardized bacterial suspension (3×10^8 CFU/ml) in PBS. Using sterile cotton buds, aliquots were drawn from the suspension and evenly swabbed on the prepared Muller Hinton agar growth medium. Sterile filter paper discs approximately of 6 mm in diameter were placed on the plates which were properly labeled according to the bacterial species and type of extract along with a series of four concentrations. From each extract, 10 μ l was carefully pipetted onto the discs and the plates were left at room temperature for about 10 min so as to allow the extracts to be diffused before incubation at 37°C for 24 hrs. thereafter zone of inhibition (in millimeters) was measured using a ruler. Amikacin (30 μ g) was used as a positive control. Each test was carried out in triplicates.

Minimum inhibitory concentration (MIC)

The MIC for each extract against the three bacterial species was determined according to previously adopted methods [28] with some modifications. A 150 μ l of Muller Hinton broth was transferred into each wells of a 96-wells flat-bottomed microtitre plate. Equal volume of each extract was added into each of the first row of the wells which were properly labeled to indicate the extracts and their respective concentrations. Using a multichannel transfer micropipette, the extracts were serially diluted to obtain concentrations between 75 and 0.59mg/ml. A 15 μ l of the bacterial suspension was pipetted into each of the wells with the broth and extract. This brings about the dilution of the bacteria 10 fold making the concentration 3×10^7 CFU/ml. A positive growth controls (broth and bacteria), negative control (broth and the diluent of each extract) and a sterility control (broth only) were also prepared in three rows of the plates. After an incubation period of 18 hrs. at 37°C, 10 μ l, 0.1% tetrazolium salt was added to each well and incubated for additional 1 hr. A colour change from colourless or faint colour to brightly coloured red – the formazans – indicates bacterial growth and no change in colour indicates inhibition of growth. The lowest sample concentration showing no color change (clear) and exhibited complete inhibition of bacterial growth is considered to be the MIC. Each test was conducted in triplicates and the means were used for comparison.

III. DATA ANALYSIS

All data were subject to one way ANOVA and univariate ANOVA in the SPSS version 20 and means were compared for significant differences using the Tukey HSD pairwise comparison. Correlation and linear regression analysis were also carried out to reveal the relationship between the various antioxidant activity assays.

IV. RESULTS

Antioxidant activity

The antioxidant activity of the various extracts were evaluated through various antioxidant activity assays including 2,2-diphenyl-1-picryl hydrazine (DPPH) radical scavenging activity, ferric reducing antioxidant power (FAP) and total phenolic contents (TPC).

2,2-Diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity

The DPPH radical is scavenging the most widely used antioxidant activity assays to evaluate the activity of bioactive components of plant extracts. The percentage DPPH scavenging activity of the various moringa extracts is shown in Table 1. While the activity is concentration dependent, univariate ANOVA ranked the various extracts in the order EL>EF>ML>AL>MF>MB>EP>AF>AP>EB>MP>AB.

Ethanol leaf extract (EL) and aqueous stem bark extract (AB) showed the highest and lowest activities, respectively with respect to overall concentrations. However, ethanol flower extract showed highest activity at the higher concentrations (94.30±1.07 and 96.33±0.20 at 7.5mg/ml and 10mg/ml, respectively). The ethanol leaf extract showed higher activity starting from the lowest concentration. Both EL and EF extracts were comparable to or even better than the synthetic antioxidant BHT or ascorbic acid. At the higher concentrations, the activity of EF extract was significantly higher (P<0.05) than the BHT or AA.

Total phenolic contents (TPC)

The result for the total phenolic contents of the various extracts is presented in Table 2. TPC is concentrations dependent with all the extracts having a positive correlation (overall $r^2 = 0.64$). Overall, the EF extract showed the highest TPC though there was no significant difference (P>0.05) as compared to the EL extract but significantly higher (P<0.05) than all the other extracts. Both EF and EL extracts revealed higher activity starting from the lowest concentration as compared to all other extracts. Aqueous flower (AF) extract was also showing considerably higher activity as compared to the other extracts except the EF and EL. In general, EF extract and AP extract showed the highest and the lowest TPC, respectively. TPC for the various extracts was in the order EF>EL>AF>EB>MF>ML>AL>MB>EP>AB>MP>AP.

Ferric reducing antioxidant power (FRAP)

The FRAP having a positive correlation with the TPC, which is also a good measure of the antioxidant activity of plant extracts. All the extracts of moringa showed good activity on a dose dependent manner. The ethanol leaf extract (EL) showed an overall higher activity with significant difference (P<0.05) while the ethanol flower (EF) extract showed its maximum activity at the highest concentrations (7.5mg/ml and 10mg/ml) surpassing all the other extracts with a significant difference (P<0.05). The FRAP for the moringa extracts was in the order EL>EF>AL>ML>EB>MF>AF>MB>EP>AP>MP>AB.

In general, the EL and AB showed the highest and the lowest FRAP values, respectively.

Correlation between the various antioxidant assays

The regression analysis shows that there is a significant (P<0.01) positive correlation between total phenolic contents and DPPH radical scavenging ($r^2 = 0.76$; $y = 0.28x + 16.89$) as well as between ferric reducing antioxidant power and total phenolic contents ($r^2 = 0.93$; $y = 1.384x + 4.794$) as shown in figure 1 and figure 2, respectively.

Table 1: Antioxidative activity of the various moringa extracts at various concentrations (15-300µg/2ml) as evaluated by the DPPH radical scavenging (%) assay

Extract***	DPPH radical scavenging activity (%)*						Overall mean
	15	45	90	150	225	300	
AB	10.47±2.16 ^{aABC}	15.07±1.81 ^{aA}	22.39±2.30 ^{bA}	27.29±0.14 ^{bcA}	32.14±3.02 ^{cdA}	35.85±0.58 ^{dA}	23.87±9.37 ^A
MB	21.00±1.07 ^{aE}	28.94±1.99 ^{bBC}	50.18±1.10 ^{cdD}	64.61±2.67 ^{dD}	69.54±3.40 ^{d^eCD}	75.67±2.79 ^{eB}	51.66±21.19 ^D
EB	9.72±0.54 ^{aAB}	19.70±2.01 ^{bAB}	32.39±1.65 ^{cB}	46.06±3.02 ^{dBC}	57.39±0.87 ^{eB}	76.89±3.20 ^{fB}	40.36±23.41 ^B
AP	12.24±0.28 ^{aB}	24.44±0.41 ^{bB}	36.49±0.63 ^{cB}	51.53±1.33 ^{dC}	65.60±2.75 ^{eC}	75.83±0.89 ^{fB}	44.36±22.97 ^C
MP	7.38±0.56 ^{aA}	16.52±2.04 ^{bA}	31.99±0.48 ^{cB}	42.56±1.39 ^{dB}	58.88±2.40 ^{eB}	74.85±2.64 ^{fB}	38.70±23.98 ^B
EP	13.98±0.79 ^{aC}	28.00±1.74 ^{bBC}	45.56±3.47 ^{cC}	59.13±6.57 ^{dD}	74.65±1.90 ^{eD}	82.93±1.58 ^{fC}	50.71±25.27 ^D
AL	16.38±0.97 ^{aD}	36.73±0.67 ^{bCD}	60.09±1.57 ^{cE}	87.74±1.02 ^{dF}	89.81±0.38 ^{dE}	88.40±0.10 ^{dE}	63.19±29.26 ^F
ML	15.66±1.24 ^a	41.04±2.89 ^{bD}	69.50±2.55 ^{cF}	90.03±3.14 ^{dFG}	93.11±0.43 ^{dEF}	93.68±0.68 ^{dEF}	67.17±30.46 ^G
EL	38.80±2.61 ^{aF}	75.30±3.53 ^{bE}	93.59±0.64 ^{cG}	94.00±0.14 ^{cFG}	94.00±0.07 ^{cEF}	93.01±0.19 ^{cEF}	81.45±20.86 ^H
AF	6.81±0.55 ^{aA}	32.29±0.96 ^{bC}	47.75±0.77 ^{cC}	58.08±1.87 ^{dCD}	71.61±2.78 ^{eD}	86.48±0.23 ^{fCD}	50.50±26.75 ^D
MF	9.83±1.69 ^{aA}	14.77±0.83 ^{bA}	52.74±1.27 ^{cD}	75.80±1.13 ^{dE}	91.72±0.88 ^{eF}	93.11±0.26 ^{eEF}	56.33±34.87 ^E
EF	16.11±2.55 ^a	41.67±0.43 ^{bD}	68.16±2.10 ^{cF}	92.74±1.31 ^{dFG}	94.30±1.07 ^{dEF}	96.33±0.20 ^{dF}	68.22±31.16 ^G
AA	42.03±0.38 ^{aF}	94.32±0.19 ^{bF}	95.12±0.13 ^{bcG}	96.26±0.20 ^{dG}	95.95±0.13 ^{cdF}	95.70±0.51 ^{cEF}	86.56±20.50 ^I
BHT**	91.61±0.99 ^G	91.61±0.99 ^F	91.61±0.99 ^G	91.61±0.99 ^{FG}	91.61±0.99 ^{EF}	91.61±0.99 ^{DE}	91.61±0.83 ^J

* Values with different lower case superscripts across a row and upper case superscripts down a column indicate significant differences (P<0.05). Values are mean±SD of triplicate samples.

** Concentration was at 0.02mg/ml

*** AB = aqueous bark extract, MB = methanolic bark extract, EB = ethanolic bark, AP = aqueous pod/fruit, MP = methanolic pod, EP = ethanolic pod, AL = aqueous leaf, ML = methanolic leaf, EL = ethanolic leaf, AF = aqueous flower, MF = methanolic flower, EF = ethanolic flower

Aqueous extract = moringa powder material solubilized in distilled water

Ethanolic extract = moringa powder material solubilized in 70% ethanol

Methanolic extract = moringa powder material solubilized in 80% methanol

Table 2: Total phenolic contents (in mg/100g dry extract as GAE) of the various moringa extracts at varying concentrations (0.5-10mg/ml)

Extract**	Total phenolic content (mg/100g)*						Overall mean
	0.5	1.5	3	5	7.5	10	
AB	16.92±0.69 ^a	44.77±0.95 ^b	57.16±0.18 ^c	69.03±0.87 ^d	99.61±9.35 ^e	116.94±0.36 ^f	67.41±34.44 ^A
MB	21.86±0.31 ^a	60.01±3.93 ^b	104.45±3.34 ^c	144.68±3.12 ^d	203.57±4.85 ^e	228.14±6.66 ^f	127.12±75.76 ^B
EB	29.57±2.46 ^a	76.82±4.69 ^b	125.01±4.41 ^c	168.35±7.62 ^d	222.61±5.57 ^e	282.54±8.42 ^f	150.82±87.91 ^C
AP	12.94±0.80 ^a	35.47±0.57 ^b	54.25±0.40 ^c	62.13±0.84 ^d	103.45±1.08 ^e	114.05±0.14 ^f	63.72±36.58 ^A
MP	8.93±0.69 ^a	34.02±3.19 ^b	53.31±2.57 ^c	68.30±3.67 ^d	98.96±0.95 ^e	127.28±2.91 ^f	65.13±40.53 ^A
EP	7.04±0.35 ^a	32.84±1.92 ^b	55.08±3.68 ^c	74.13±4.09 ^d	103.54±3.17 ^e	136.73±6.79 ^f	68.23±44.47 ^A
AL	8.83±0.09 ^a	70.55±29.08 ^b	139.16±1.77 ^c	186.18±2.94 ^d	224.60±3.56 ^e	253.70±1.64 ^e	147.17±88.63 ^C
ML	22.46±1.54 ^a	78.15±1.72 ^b	133.35±2.09 ^c	169.58±3.27 ^d	229.63±4.62 ^e	264.12±6.05 ^f	149.55±85.58 ^C
EL	37.83±1.36 ^a	102.62±3.37 ^b	167.78±5.00 ^c	218.38±2.99 ^d	287.26±1.8 ^e	326.87±7.16 ^f	190.12±103.2 ^E
AF	32.84±1.12 ^a	96.74±2.33 ^b	151.28±4.94 ^c	179.54±1.09 ^d	245.22±6.49 ^e	276.21±4.63 ^f	163.64±85.45 ^D
MF	28.53±0.87 ^a	40.29±1.64 ^b	135.79±3.86 ^c	181.74±1.34 ^d	246.14±4.14 ^e	271.51±3.95 ^f	150.67±95.83 ^C
EF	35.69±2.19 ^a	95.02±2.09 ^b	156.31±1.84 ^c	200.42±3.33 ^d	303.68±12.37 ^e	349.80±3.45 ^f	190.15±113.24 ^E
Mean	21.95±10.73 ^a	63.94±26.48 ^b	111.08±43.13 ^c	143.54±56.66 ^d	197.35±73.86 ^e	228.99±81.64 ^f	127.81±90.02

* Values with different lower case superscripts across a row and upper case superscripts down a column indicate significant differences (P<0.05). Values are mean±SD of triplicate samples.

** AB = aqueous bark, MB = methanolic bark, EB = ethanolic bark, AP = aqueous pod/fruit, MP = methanolic pod, EP = ethanolic pod, AL = aqueous leaf, ML = methanolic leaf, EL = ethanolic leaf, AF = aqueous flower, MF = methanolic flower, EF = ethanolic flower.

Table 3: Concentration-dependent antioxidative activity of the various moringa extracts by the ferric reducing antioxidant power – FRAP assay expressed in millimole/100g dry extract as Fe(II)-sulphate equivalent, (extract concentrations 0.5-10mg/ml)

Extract**	FRAP (mM/100mg)*						Overall mean
	0.5	1.5	3	5	7.5	10	
AB	10.15±0.78 ^a	42.62±2.16 ^b	63.26±3.70 ^c	76.35±3.95 ^d	110.32±2.05 ^e	148.58±9.12 ^f	75.21±46.28 ^A
MB	9.4±0.48 ^a	58.11±5.43 ^b	115.6±5.37 ^c	182.05±6.03 ^d	265.15±16.95 ^e	312.61±19.26 ^f	157.15±111.4 ^D
EB	19.23±4.02 ^a	90.76±8.65 ^b	162.21±2.58 ^c	249.2±4.01 ^d	330.39±25.46 ^e	445.25±2.69 ^f	216.17±148.25 ^F
AP	16.38±2.45 ^a	56.54±4.23 ^b	89.08±4.67 ^b ^c	103.23±11.75 ^c	181.70±25.13 ^d	204.99±10.10 ^d	108.65±68.86 ^B
EP	17.96±1.99 ^a	56.38±7.26 ^b	104.79±9.83 ^c	148.75±7.11 ^d	219.96±26.88 ^e	281.25±10.79 ^f	138.18±94.14 ^C
MP	9.28±1.75 ^a	52.24±4.12 ^b	93.29±13.95 ^c	97.37±5.12 ^c	164.24±6.94 ^d	190.74±6.76 ^e	101.19±63.90 ^B
AL	46.54±0.5 ^a	142.39±5.39 ^b	243.03±8.51 ^c	321.83±6.85 ^d	352.08±1.85 ^e	356.09±1.37 ^e	243.66±118.61 ^G
ML	25.87±2.44 ^a	114.96±2.36 ^b	213.58±8.96 ^c	295.16±12.23 ^d	325.98±4.16 ^e	329.20±1.25 ^e	217.46±117.1 ^F
EL	47.34±0.65 ^a	182.35±16.88 ^b	308.47±16.10 ^c	359.27±3.87 ^d	367.96±1.44 ^d	364.50±1.71 ^d	271.65±122.9 ^H
AF	12.76±0.91 ^a	82.69±4.12 ^b	159.84±2.66 ^c	206.75±11.04 ^d	310.36±5.04 ^e	362.82±3.18 ^f	189.20±125.03 ^E
MF	21.79±1.46 ^a	35.67±1.13 ^a	171.66±3.90 ^b	242.83±41.8 ^c	391.94±10.56 ^d	414.81±18.45 ^d	213.12±159.87 ^F
EF	24.42±1.88 ^a	107.31±3.10 ^b	207.1±7.36 ^c	289.86±14.99 ^d	392.61±25.79 ^e	472.92±16.22 ^f	249.04±160.25 ^G
Mean	21.76±12.74 ^{aA}	85.17±43.64 ^{bB}	160.99±70.86 ^{cC}	214.39±92.13 ^{dD}	284.39±93.17 ^{eE}	323.65±99.23 ^{fF}	181.72±129.56

*Values with different lower case superscripts across a row and upper case superscripts down a column indicate significant differences (P<0.05). Values are mean±SD of triplicate samples.

**AB = aqueous bark, MB = methanolic bark, EB = ethanolic bark, AP = aqueous pod/fruit, MP = methanolic pod, EP = ethanolic pod, AL = aqueous leaf, ML = methanolic leaf, EL = ethanolic leaf, AF = aqueous flower, MF = methanolic flower, EF = ethanolic flower

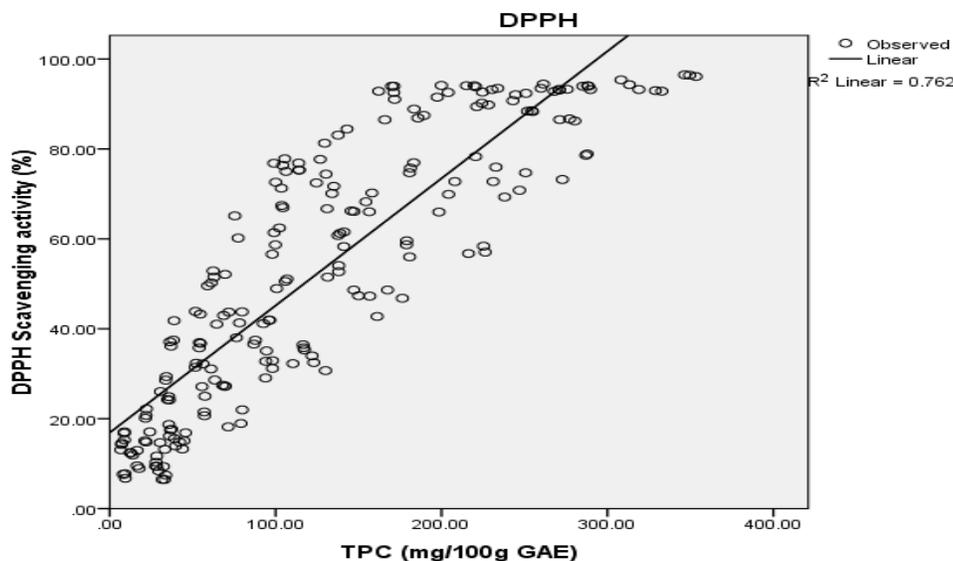


Figure 1: Correlation between total phenolic content and DPPH radical scavenging activity for the various Moringa extracts tested on six concentrations ($r^2 = 0.76$; $y = 0.28x + 16.89$)

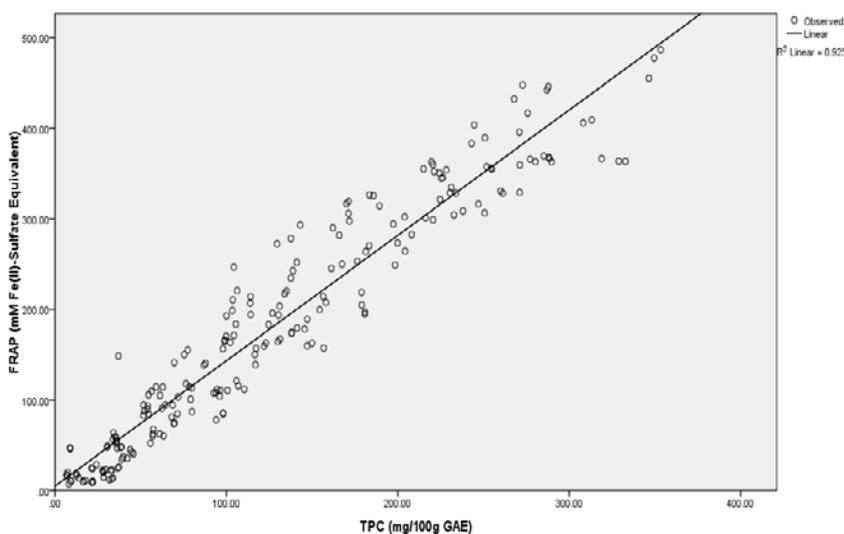


Figure 2: Correlation between total phenolic content and ferric reducing antioxidant power for the various Moringa extracts tested on six concentrations ($r^2 = 0.93$; $y = 1.384x + 4.794$)

Antimicrobial properties of moringa extracts

Results for the antimicrobial activity by the MIC and zone of inhibition method are presented in Table 4 and Table 5, respectively. With both the MIC and zone of inhibition assays, all the extracts exhibited antimicrobial activities at varying degrees.

The MIC assay against the three bacteria, *Aeromonas hydrophila*, *Micrococcus luteus* and *Staphylococcus aureus* showed significant difference ($P < 0.050$) among the various extracts. In general, the ethanolic extracts of all the moringa parts showed higher antimicrobial activity against the three species of bacteria. With all the three species, AB extract showed the least activity, while EL against *M. luteus* and EF extract against *A.*

hydrophila and *S. aureus* exhibited highest activity ($P < 0.05$). Overall, EF extract followed by EL extract revealed the lowest MIC (5.33 ± 1.12 and 7.95 ± 3.82 , respectively) with significant difference ($P < 0.05$). Comparison between the three species over all the extracts also revealed significant difference ($P < 0.05$), whereby *S. aureus* and *A. hydrophila* exhibited lowest and highest MIC, respectively.

With the disc diffusion assay, ethanolic bark and pod extracts were more efficient with significantly higher zone of inhibition, followed by ethanolic flower and leaf extracts for *A. hydrophila*. For *M. luteus*, ethanolic bark extract resulted in significantly higher ($P < 0.05$) inhibition zone followed by ethanolic flower and leaf extracts.

Table 4: Antimicrobial susceptibility of moringa extracts against *Aeromonas hydrophila* and *Micrococcus luteus* by the minimum inhibitory concentration (MIC) assay

Extracts	MIC (mg/ml)			
	<i>Aeromonas hydrophila</i>	<i>Micrococcus luteus</i>	<i>Staphylococcus aureus</i>	Overall mean
AB	45.66 ± 1.89 ^{fA}	47.54 ± .00 ^{gA}	36.88 ± 1.22 ^{eB}	43.36 ± 5.05 ^h
MB	12.20 ± 1.20 ^{bc}	11.00 ± .00 ^{cd}	11.00 ± .00 ^{bc}	11.40 ± .85 ^{cde}
EB	11.00 ± .00 ^{bcB}	9.47 ± .74 ^{cA}	10.50 ± .00 ^{bBC}	10.32 ± .77 ^{cd}
AP	22.83 ± 2.08 ^{eB}	33.20 ± .00 ^{fC}	15.80 ± .80 ^{dA}	23.94 ± 7.66 ^g
MP	12.20 ± 1.00 ^{bc}	10.55 ± .65 ^{cd}	11.80 ± 2.42 ^{bc}	11.52 ± 1.54 ^{de}
EP	10.00 ± .00 ^{bb}	10.17 ± .23 ^{cdB}	8.70 ± .00 ^{bA}	9.62 ± .71 ^{bc}
AL	14.80 ± .00 ^{cd}	14.80 ± .00 ^e	15.80 ± 1.00 ^d	15.13 ± .71 ^f
ML	12.77 ± 1.33 ^{bc}	11.90 ± .00 ^d	14.03 ± 2.81 ^{cd}	12.90 ± 1.81 ^e
EL	12.05 ± 1.34 ^{bcC}	3.40 ± .00 ^{aA}	8.40 ± .00 ^{bb}	7.95 ± 3.82 ^b
AF	16.75 ± 1.55 ^{dC}	11.55 ± .00 ^{dB}	10.29 ± 1.14 ^{bcA}	12.86 ± 3.12 ^e
MF	12.63 ± 1.79 ^{bc}	11.18 ± 1.93 ^{cd}	10.76 ± 1.69 ^{bc}	11.52 ± 1.78 ^{de}
EF	5.96 ± .80 ^{ab}	5.96 ± .80 ^{bb}	4.06 ± .419 ^{aA}	5.33 ± 1.12 ^a
Overall mean	15.74 ± 10.09 ^C	15.06 ± 12.20 ^B	13.19 ± 7.99 ^A	14.66 ± 10.17

Lower case superscripts down a column and uppercase superscripts across a row indicate significant differences (P<0.05). Values are mean ± SEM for triplicate samples.

Table 5: Concentration-dependent antimicrobial susceptibility of *Moringa oleifera* extracts against *Aeromonas hydrophila* and *Micrococcus luteus* at varying concentrations (20, 35, 50 and 65 mg/ml) assayed by the agar plate disc diffusion method.

Bacteria species	Extract	Zone of inhibition (diameter in mm)				Overall mean
		20	35	50	65	
<i>Aeromonas hydrophila</i>	AB	10.00±.00 ^{bc}	10.00±.00 ^{bcd}	12.00±.00 ^{bcd}	11.00±.00 ^{bcd}	10.75±.87 ^c
	EB	13.50±.50 ^d	14.00±1.00 ^g	15.00±1.00 ^d	13.50±1.5 ^{defg}	14.00±1.11 ^g
	MB	9.00±.00 ^{bcd}	7.00±.00 ^a	10.00±.00 ^{ab}	10.00±.00 ^{abc}	9.00±1.28 ^b
	AF	8.500±.50 ^{abcA}	10.00±.00 ^{bcdB}	11.50±.50 ^{bcC}	13.00±.00 ^{efgD}	10.75±1.78 ^e
	EF	10.50±1.50 ^{bc}	12.00±.00 ^{ef}	12.50±2.50 ^{bcd}	14.50±2.50 ^{fg}	12.38±2.22 ^f
	MF	9.00±.00 ^{bcdA}	10.50±.50 ^{cdeB}	10.00±.00 ^{abB}	14.00±.00 ^{efgC}	10.87±1.98 ^e
	AL	7.50±.50 ^{abA}	9.00±.00 ^{bcB}	10.50±.50 ^{abC}	11.50±.50 ^{cdeC}	9.62±1.63 ^{cd}
	EL	11.00±1.00 ^{ca}	11.00±1.00 ^{deA}	11.50±1.50 ^{bA}	15.50±.50 ^{gB}	12.25±2.17 ^f
	ML	8.50±.50 ^{abcA}	9.00±1.00 ^{bcA}	10.50±1.50 ^{abAB}	12.50±.50 ^{cdeB}	10.13±1.82 ^{de}
	AP	7.50±.50 ^{ab}	8.50±.50 ^{ab}	8.00±1.00 ^a	8.50±.50 ^{ab}	8.13±.71 ^{ab}
	EP	12.00±.00 ^{cdA}	13.00±.00 ^{fgB}	14.50±.50 ^{cC}	15.00±.00 ^{fgC}	13.62±1.26 ^g
	MP	7.00±.00 ^a	7.00±.00 ^a	7.50±.50 ^a	7.50±.50 ^a	7.25±.4 ^a
	Amikacin*	20				
<i>Micrococcus luteus</i>	AB	8.00±.00 ^{abA}	8.00±.00 ^{abcA}	9.50±.50 ^{bcdB}	10.50±.50 ^{bcC}	9.00±1.15 ^b
	EB	16.50±1.5 ^d	17.00±1.00 ^g	16.50±1.50 ^f	18.50±.50 ^f	17.13±1.33 ^e
	MB	12.00±2.0 ^{bc}	10.50±.50 ^e	12.50±1.50 ^e	11.00±1.0 ^{bc}	11.50±1.43 ^c
	AF	7.00±.00 ^{aA}	8.50±.50 ^{bcB}	10.00±.00 ^{cdC}	11.50±.50 ^{bcdD}	9.25±1.78 ^b
	EF	10.00±.00 ^b	13.00±.00 ^f	15.00±.00 ^f	17.00±.00 ^e	13.75±2.70 ^d
	MF	7.00±.00 ^a	7.00±.00 ^a	11.00±.00 ^{de}	12.00±.00 ^{cd}	9.25±2.39 ^b
	AL	8.00±.00 ^{abA}	8.50±.50 ^{bcA}	9.50±.50 ^{bcdB}	11.00±.00 ^{bcC}	9.25±1.23 ^b
	EL	13.00±.00 ^c	11.00±.00 ^e	16.00±.00 ^f	13.00±.00 ^d	13.25±1.86 ^d
	ML	8.00±.00 ^{abA}	9.00±.00 ^{cdB}	9.00±.00 ^{abcB}	11.50±.50 ^{bcC}	9.37±1.37 ^b
	AP	7.00±.00 ^{aA}	7.50±.50 ^{abAB}	8.00±.00 ^{abBC}	8.50±.50 ^{aC}	7.75±.66 ^a
	EP	9.00±.00 ^{ab}	10.00±.00 ^{de}	12.00±.00 ^e	13.00±.00 ^d	11.00±1.65 ^c
	MP	7.00±.00 ^a	7.00±.00 ^a	7.50±.50 ^a	7.50±.50 ^a	7.25±.40 ^a
	Amikacin*	20				

Lower case superscripts down a column and uppercase superscripts across a row for each group of bacteria indicate significant differences (P<0.05). Values are mean ± SD for triplicate samples.

* Amikacin at 30µg/disc (HIMEDIA, India)

V. DISCUSSION

The growing concern of adverse health impacts of synthetic antioxidants and drugs has led to the discovery of natural herbal and plant bioactive principles that are believed to have high activity against damaging reactive oxygen species and various microbial infections. *Moringa oleifera* is among the most common and widely used plants for their extracts to be used as antioxidant and antimicrobial agents. However, no work has shown the concurrent evaluation and comparison of solvent-specific extracts from the various parts of the plant.

In the current study, although all the extracts were showing considerable activity, the 70% ethanolic extract of leaf and flower exhibited highest antioxidant activity ($P < 0.05$). Antioxidant activity is highly correlated to the polyphenolic contents of the particular extract. These bioactive compounds are maximally extracted in solvents that have moderate polarity, such as ethanol and methanol [29, 30] which is supportive for the findings of this study. Moreover, polyphenolic bioactive compounds are maximally extracted at 80% and 70% methanolic and ethanolic solvents, respectively [13], which is in agreement with the findings of our study. At 10mg/ml, EF, EL and ML revealed significantly higher activity ($P < 0.05$) as compared to the synthetic antioxidant, BHT. At the same concentration, the EF extract showed higher activity than ascorbic acid. The strong positive correlation ($r = 0.93$) between TPC and FRAP which is similar to the findings for gold mohar flower, leaves and bark extracts [31] as well as between TCP and DPPH ($r = 0.76$) which is similar to that of some Malaysian plants [32] suggests that phenolic compounds in plant extracts might have acted as powerful radical scavenging and reducing agents. The results of all the antioxidative assays in the current study suggest that ethanolic *M. oleifera* extracts can be good substitutes for the synthetic antioxidants, which are suspected for their negative impact on the health of human and animals. Although the antioxidative efficacy of ethanolic and methanolic extracts is comparable, the ethanolic extract is more suitable for nutraceutical purposes for the reason that methanolic extraction may leave residues that lead to toxicity even at low concentrations [33].

Various researches on phytochemical screening of *M. oleifera* extracts indicate the presence of alkaloids, tannins, flavonoids, polyphenols, saponins, essential oils, etc., which contribute to the antimicrobial properties of the extracts [34]. These phytochemicals are present in almost all tissues of the plant including the leaves, roots, stem, fruits [35] and flowers. Specifically, ethanolic extracts are rich in alkaloids, terpenoids and propolis [36] that are believed to have high antimicrobial properties. In the current study, ethanolic extract of all the tested moringa tree parts (leaves, flowers, bark and fruit) showed highest antimicrobial activity with both the MIC and disc diffusion assays. With the disc diffusion method, aqueous and methanolic extracts of stem bark also showed higher antimicrobial activities as compared to their counterpart extracts of leaf, flower and fruit. The antimicrobial activities of the bioactive phytochemicals may involve multiple mechanisms of action. For instance, oil acts by degrading the cell wall and interacting with the composition resulting in the ultimate disruption of the cytoplasmic membrane [37]. Moreover, oils

damage membrane protein, interfere with membrane integrated enzymes, cause leakage of cellular components, coagulate cytoplasm, deplete the proton motive force, change fatty acid and phospholipid constituents, alter nutrient uptake and electron transport and impair enzymatic mechanism for energy [38]. Findings of the current study indicated that the microbial inhibition potency of the extracts is related to their TPC. This is in agreement with the work of some co-authors who suggested that the inhibition of microorganisms by phenolic compounds may be due to iron deprivation or hydrogen bonding with vital proteins such as microbial enzymes [39]. Phenolic compounds show generally a good antimicrobial effectiveness against Gram-positive bacteria with their effect dependent on their amount: at low concentrations they are able to interfere with enzymes involved in the production of energy; at higher concentrations, they can induce the denaturation of proteins until an irreversible modification of the cell and death [40]. Antimicrobial activity may also be due to the presence of short peptides that may act directly on microorganisms and result in growth inhibition by disrupting cell membrane synthesis or synthesis of essential enzymes [41].

In the current study, all the extracts of moringa exhibited antimicrobial effect at varying degrees, a number of them with significant difference ($P < 0.05$) in susceptibility between the Gram-negative bacterium (*Aeromonas hydrophila*) and Gram-positive bacteria (*Micrococcus luteus* and *Staphylococcus aureus*). The variation in susceptibility between Gram-negative and Gram-positive bacteria may be attributable to the structural difference in the cell membrane of the two groups of bacteria (the presence of outer membrane – the lipopolysaccharide – in the Gram-negative bacteria makes access to the gram-negative bacteria more restrictive) [42]. The EF extract did not show significant difference between *A. hydrophila* and *M. luteus*. This may be indicative that moringa extracts, specifically the ethanolic extract of flower can be used as a wide spectrum antimicrobial agent to prevent both the Gram-positive and Gram-negative bacteria.

VI. CONCLUSION

Moringa oleifera extracts from all the tested parts of the plant exhibited high potency of antioxidative activities and antimicrobial properties against both Gram-negative and Gram-positive bacteria in a concentration dependent manner. Ethanolic extracts of all the moringa parts showed highest activity as compared to the aqueous or methanolic extracts. This is probably attributable to the high phenolic contents (which are positively correlated to the antioxidative and antimicrobial activities) of this extract suggesting the choice of extraction solvent is a critical factor for obtaining the desired bioactive compounds in the plant extracts. With the growing concern of the health impairments of the synthetic antioxidants that are commonly used as food/feed preservatives in the processing industry, moringa extracts can be alternatives to substitute these noxious synthetic chemicals. The powerful antimicrobial properties of the ethanolic extracts of moringa against both the Gram-positive and Gram-negative bacteria also suggests a promising natural alternative for the synthetic drugs that are also not immunized from the blame for their negative health impacts on human and animals. Among the

ethanolic extracts of the different parts of *M. oleifera*, the extracts of flower and leaf signified best activities and can be recommended as prophylactic agents against oxidative stress and infectious diseases. However, characterization and detailed studies on the specific components of the bioactive crude extracts responsible for the antioxidative and antimicrobial attributes and their mechanism of action is required for the better understanding of their application as immunomodulators.

ACKNOWLEDGMENT

The first author would like to acknowledge the National Board for Higher Education, Government of Eritrea for providing the financial support to carry out the research project. We also greatly acknowledge ICAR and Dr. W. S. Lakra, Director, Central Institute of Fisheries Education, Mumbai, for providing all the laboratory and research facilities.

REFERENCES

[1] Bayr, H. MD, Reactive oxygen species. *Critical Care Medicine*: 2005: 33(12): S498-S501

[2] Krushynska, O. A., Olga A. Zaporozhets, Natalia A. Lipkovska and Valentina N. Barvinchenko, A New Test Method for the Evaluation of Total Antioxidant Activity of Herbal Products. *J. Agric. Food Chem.* 2004: 52(21). p. 25.

[3] Alina A., Cristea V., Iulia G., Lorena D., Angela D., Mirela C. M, Săndița I. P. and Coadă M.T., The influence of some probiotics on oxidative stress at *Oreochromis niloticus* grown in an intensive recirculating aquaculture system. *Lucrări Științifice-Seria Zootehnie*, 2013: 59.

[4] Bauer A. K., Lori D. Dwyer-Nield, Joseph A. H., Robert C. M. and Alvin M. M. The lung tumor promoter, butylated hydroxytoluene (BHT), causes chronic inflammation in promotion-sensitive BALB/cByJ mice but not in promotion-resistant C57BL/6 mice. *Toxicology*, 2001: 169, pp. 1–15

[5] Fawole, F. J., Sahu, N. P., Pal, A. K. and Lakra, W. S., Evaluation of antioxidant and antimicrobial properties of selected Indian medicinal plants. *Int. J. Med. Arom. Plants*, 2013: 3(1), pp. 69-77.

[6] Chew B. P., . Antioxidant vitamins affect food animal immunity and health, *J. Nutri.* 1995: 125, pp. 18045-18085.

[7] Innocent, B. Xavier, M. Syed Ali Fathima and A. Sivagurunathan, Haematology of *Cirrhinus mrigala* fed with Vitamin C supplemented diet and post challenged by *Aphanomyces invadens*; *Journal of Applied Pharmaceutical Science*, 2011: 1 (9), pp. 141-144.

[8] Makkar, H. P. S. and Becker, k. Nutrients and antiquality factors in different morphological parts of the *Moringa oleifera* tree. *J. Ag. Sci.* 1997: 128, pp. 311-322.

[9] Okechukwu U., Nwodo P. C., Okwesili F. C., Joshua P. E., Bawa Abubakar, Ossai Emmanuel and Odo Christian E. Phytochemical and acute toxicity studies of *Moringa oleifera* ethanolic leaf extract. *Int. J. LifeSc. Bt & Pharm. Res.* 2013: 2(2), pp. 67-71.

[10] Anwar F, Latif S, Ashraf M and Gilani AH. *Moringa oleifera*: a food plant with multiple medicinal uses. *Phytotherapy Research*, 2007: 21(1), pp.17–25.

[11] Caceres, A., Saravia, A., Rizzo, S., Zabala, L., De Leon, E. and Nave, F. Pharmacologic properties of *Moringa oleifera*. 2: screening for antispasmodic, antiinflammatory and diuretic activity. *Journal of Ethnopharmacology*, 1992: 36(3), pp.233–237.

[12] Gilani, A.H., Aftab, K. and Suria, A. Pharmacological studies on hypotensive and spasmolytic activities of pure compounds from *Moringa oleifera*. *Phytotherapy Research*, 1994: 8(2) pp.87–91.

[13] Siddhuraju P. and Becker K. Antioxidant properties of various solvent extracts of total phenolic constituents from three different agroclimatic origins of drumstick tree (*Moringa oleifera* Lam) leaves. *J. Agric Food Chem.* 2003: 51(8) pp. 2144-2155.

[14] Das, B.R., Kurup, P.A. and Rao, P.L. Antibiotic principle from *Moringa pterygosperma*. VII. Antibacterial activity and chemical structure of compounds related to pterygospermin. *The Indian Journal of Medical Research*. 1957: 45(2) pp.191–196.

[15] Eilert, U., Wolters, B. and Nahrstedt, A. The antibiotic principle of seeds of *Moringa oleifera* and *Moringa stenopetala*. *Planta Medica*, 1981: 42(1), pp.55–61.

[16] Gilani, A.H., Janbaz, K.H. and Shah, B.H. Quercetin exhibits hepatoprotective activity in rats. *Biochemical Society Transactions*, 1997: 25, article 85.

[17] Sayeed, A. M., Hossain, S. M., Chowdhury, M. E. H. and Haque, M. In vitro Antimicrobial Activity of Methanolic Extract of *Moringa oleifera* Lam. *Fruits. Journal of Pharmacognosy and Phytochemistry*, 2012: 1(4), pp. 94.

[18] Oliveira, J.T.A., Silveira, S.B., Vasconcelos, I.M., Cavada, B.S. and Moreira, R. A. Compositional and nutritional attributes of seeds from the multiple purpose tree *Moringa oleifera* Lamarck. *Journal of the Science of Food and Agriculture*. 1999: 79(6), pp.815–820.

[19] Aslam, M. F., Anwar R., Nadeem U., Rashid T.G., Kazi A. and Nadeem M. Mineral composition of *Moringa oleifera* leaves and pods from different regions of Punjab, Pakistan *Asian J. Plant Sci.* 2005: 4, pp 417–42.

[20] Saalu L. C., Osinubi A. A., Akinbami A. A, Yama, O. E., Oyewopo, A. O. and Enaibe, B. U. *Moringa oleifera* Lamarck (drumstick) Leaf Extract Modulates the Evidences of Hydroxyurea –Induced Testicular Derangement. *International Journal of Applied Research in Natural Products*, 2011: 4 (2), pp. 32-45.

[21] Hettiarachchy, S. N., Min Zhang, Ronny H., Arvind, K., Apputhury, Praisoody, M. D., Arumugam M. and Chandrasekhara R. M. Phytochemicals, antioxidant and antimicrobial activity of *Hibiscus sabdariffa*, *Centella asiatica*, *Moringa oleifera* and *Murraya koenigii* leaves. *Journal of Medicinal Plants Research*, 2011: 5(30), pp. 6672-6680.

[22] Luqman, S., Srivastava, S., Kumar, R., Maurya, A. K. and Chanda, D. Experimental Assessment of *Moringa oleifera* Leaf and Fruit for its Antistress, Antioxidant, and Scavenging Potential Using In Vitro and In Vivo Assays. *Evid Based Complement Alternat Med.* 2012: 519084.

[23] Farooq F., Meenu R., Avinash T., Abdul Arif K. and Farooq S. Medicinal properties of *Moringa oleifera*: An overview of promising healer. *Journal of Medicinal Plants Research*, 2012: 6(27), pp. 4368-4374.

[24] Jameel F., Vijayalakshmi, Satish Kumar M. C., Sanjeeva, Prabhath K. G., Benegal A., Udupa A. L. and Rathnakar U. P. Antiurolithiatic activity of aqueous extract of bark of *Moringa oleifera* (Lam.) in rats. *Health*, 2010: 2(4), pp. 352-355

[25] Kim MK, Lee H.S., Kim E.J., Won N.H, Chi Y.M, Kim B.C. and Lee K.W. Protective effect of aqueous extract of *Perilla frutescens* on tert-butyl hydroperoxide-induced oxidative hepatotoxicity in rats. *Food and Chemical Toxicology*, 2007: 45, pp. 1738–1744

[26] Singleton, V. L. & Rossi. J. A. Jr, Colorimetry of total phenolics with phosphomolybdic phosphotungstic acid reagents. *Amer. J. Enol. Viticult.* 1965: 16, pp. 144-58.

[27] Oyas Ahmed Asimi, N. P. Sahu and A.K. Pal, Antioxidant activity and antimicrobial property of some Indian spices. *International Journal of Scientific and Research Publications*, 2013: 3(3), pp. 1-8.

[28] Perumal S., Pillai S., Lee W. C., Mahmud R and Ramanathan S. Determination of Minimum Inhibitory Concentration of *Euphorbia hirta* (L.) Extracts by Tetrazolium Microplate Assay. *Journal of Natural Products*, 2012: 5, pp. 68-76.

[29] Chenielle D., Lois R., Alison N., Sylvia M., John L. and Mohammed A. Antibacterial and antifungal analysis of crude extracts from the leaves of *Callistemon viminalis*. *Journal of Medical and Biological Science*, 2009: 3(1), pp. 1-7.

[30] Houghton P. and Raman A. *Laboratory Handbook for the Fractionation of Natural Extracts*. Springer US, Science, 1998. 199 pages

[31] Shabir G., Anwar F, Sultana B, Khalid ZM, Afzal M, Khan QM and Ashrafuzzaman M. Antioxidant and antimicrobial attributes and phenolics of different solvent extracts from leaves, flowers and bark of Gold Mohar [*Delonix regia* (Bojer ex Hook.) Raf]. *Molecules*, 2009:14, pp. 2167-2180.

[32] Qader S. Wasman., Abdulla M. A., Lee S. C., Nigar N., Zain M. M. and Hamdan S. Antioxidant, Total Phenolic Content and Cytotoxicity Evaluation of Selected Malaysian Plants. *Molecules*, 2011: 16, pp. 3433-3443

- [33] Paine A. and Davan AD, Defining a tolerable concentration of methanol in alcoholic drinks. *Hum Exp Toxicol*, 2001:20(11), pp. 563-8.
- [34] Patil SD and Jane R. Antimicrobial activity of *Moringa oleifera* and its synergism with *Cleome viscosa*. *Int. J. of Life Sciences*, 2013: 1(3), pp. 182-189.
- [35] Siddiqui S, Verma A, Rather AA, Jabeen F and Meghvansi MK, Preliminary phytochemicals analysis of some important medicinal and aromatic plants. *Advan. Biol. Res.*, 2009: 3(5-6), pp. 188-195.
- [36] Cowan M. M. Plant Products as Antimicrobial Agents. *Linical Microbiology Reviews*, 1999: 12(4) pp. 564-582.
- [37] Khanahmadi M, Rezazadeh SH and Taran M, In vitro antimicrobial and antioxidant properties of *Smyrnum cordifolium* Boiss. (Umbelliferae) extract. *Asian J. Plant Sci.*, 2010: 9(2) pp. 99-103.
- [38] Baldemir AM, Coskun and Yildiz S. Antimicrobial activity of *Ferula halophla*. *FABAD J. Pharm. Sci.*, 2006: 31, pp. 57-61
- [39] Karou D., Dicko M. H., Jacques S. and Traore A. S. Antioxidant and antibacterial activities of polyphenols from ethnomedicinal plants of Burkina Faso. *African Journal of Biotechnology*, 2005: 4 (8), pp. 823-828.
- [40] Marrufo T., Filomena N., Emilia M., Florinda F., Raffaele C., Laura D. M., Adelaide B. A. and Vincenzo D. F. Chemical composition and biological activity of the essential oil from leaves of *Moringa oleifera* lam. Cultivated in mozambique. *Molecules*, 2013: 18, pp. 10989-11000.
- [41] Silvestro L, Weiser JN, Axelsen PH. Antibacterial and antimembrane activities of cecropin A in *Escherichia coli*. *Antimicrob Agents Chemother*. 2000: 44(3), pp. 602-7.
- [42] Pascal J. D., Kareen S., Benoit G. and Mazza G. Antimicrobial activity of individual and mixed fractions of dill, cilantro, coriander and eucalyptus

essential oils. *International Journal of Food Microbiology*, 2002: 74, pp. 101 – 109.

AUTHORS

First Author - Esayas Welday Tekle, Fish Nutrition, Biochemistry and Physiology Division, Central Institute of Fisheries Education, Mumbai, Maharashtra, India. Email- e_welday@yahoo.com

Second Author - Dr. N. P. Sahu, Principal Scientist and HOD, Fish Nutrition, Biochemistry and Physiology Division, Central Institute of Fisheries Education, Mumbai, Maharashtra, India. Email- npsahu@cife.edu.in

Third author - Dr. Makesh M., Senior Scientist, Aquatic Environment and Health Management Division, Central Institute of Fisheries Education, Mumbai, Maharashtra, India. Email- mmakesh@cife.edu.in

Correspondence author- Dr. N. P. Sahu, Principal Scientist and HOD, Fish Nutrition, Biochemistry and Physiology Division, Central Institute of Fisheries Education, Mumbai, Maharashtra, India. Email- npsahu@cife.edu.in

Discovery of Frequently Occurring Approximate sub sequences with distance

Ms. V. V. Kamble *, Mr. S. V. Kamble **

* COEP Pune, India

** Flora Institute of Technology, Pune, India

Abstract- Frequent pattern mining from sequential datasets is an important data mining method. It has various applications like discovery of motifs in DNA sequences, financial industry, the analysis of web log, customer shopping sequences and the investigation of scientific or medical processes etc. Motif mining requires efficient mining of approximate patterns that are contiguous. The main challenge in discovering frequently occurring patterns is to allow for some noise or mismatches in the matching process. Existing algorithms focus on mining subsequences but very few algorithms find approximate pattern mining. In this paper we have presented a new method for finding frequently occurring approximate sequences from sequential datasets. Proposed method uses suffix trees for discovering frequent pattern with fixed length, maximum distance & minimum support.

Index Terms- data mining; sequence mining; frequent patterns; suffix tree;

I. INTRODUCTION

Sequential pattern mining deals with data in large sequential data sets. Sequence mining has gained popularity in marketing in retail industry, biomedical research, DNA sequence patterns, financial industry. It is most common applications are discovery of motifs in DNA sequences, financial industry use data mining to identify interesting share price movements, the analysis of web log for web usage, customer shopping sequences and the investigation of scientific or medical processes and so on. The results of pattern mining can be used for business management marketing, planning and prediction. The difficulty in discovering frequent patterns is to allow for some noise in the matching process. The most important part of pattern discovery is the definition of a pattern and similarity between two patterns which may vary from one application to another.

Agarwal has started work in this area for association rule mining. It analyses customer buying behaviour by finding associations between the different items that customer's buy. Discovering frequent patterns is computationally expensive process and counting the instances of pattern requires a large amount of processing time. Huge amount of literature is available and number of algorithms is proposed for mining the frequent patterns or itemsets. These algorithms differ in their ways of traversing the itemset lattice, dimension and the way in which they handle the database; i.e., how many passes they make over the entire database and how they reduce the size of the processed database in each pass.

In this paper we focus on repeated occurrences of short approximate sequences, i.e. occurrences are not always identical such sub sequences is also called as frequently occurring approximate sequences. There are two types of subsequence, non-contiguous subsequence and contiguous subsequence. If sequence A=abcabc and B=abccb then sequence B is non-contiguous subsequence of A by choosing first, second, third, fifth, and sixth element from sequence A. We focus on discovering the contiguous subsequence of fixed length because non-contiguous subsequence mining is not applicable in DNA and protein sequence mining applications. Some algorithms [1] [2] [3] [4] are available to mine contiguous sub sequences. We have presented a method for discovering frequently occurring approximate pattern of fixed length. It uses suffix tree because suffix tree is a data structure that presents the suffixes of a string from sequential dataset that allows for a particularly fast implementation. This approach is applicable in many real life and biomedical applications such as bioinformatics for finding patterns in long noisy DNA sequence and protein motif mining. Section 2 presents related work, section 3 describes problem definition, section 4 describes proposed work and section 5 describes summaries.

II. RELATED WORK

J. Han and M. Kamber[5] stated, data mining is process of extracting knowledge from large database. Data mining is also referred as knowledge discovery from data or KDD. There exist a large number of algorithms for sequential pattern mining and each algorithm is having different features. Early work focused on mining association rules. Later AprioriAll algorithm is derived from the Apriori algorithm. In these types of algorithms, candidate sequences are generated and stored. After these algorithms main goal is to reduce the number of candidate sequences generated so as to minimize input output cost. In another type of algorithm support is counted and it is used to test the frequency. The key strategy here is to eliminate any database or data structure that is maintained all the time for counting the support. Usually, a proposed algorithm also has a proposed data structure, such as SPADE by Zaki 1998 uses vertical databases; PrefixSpan[6] uses projected databases; FLAME[8] uses count suffix tree. current Algorithms in the area can be classified into three main categories, namely, apriori-based, pattern-growth, and early-pruning with a fourth category as a hybrid of the main three [7].

The problem of subsequence mining was introduced in [9]. Later on several other algorithms have proposed as improvement

on [9] such algorithms are SPADE [10] and BIDE [1]. Statistical sampling based method [11] uses compatibility matrix to find patterns in presence of noise. Most of the algorithms like CloSpan[2] are presented to mine exact motifs, such algorithms does not allow noise in matching process. FLAME [8] algorithm is discovering motif and it allow noise in matching process, so it is efficient for approximate substrings. FAS-Miner [12] algorithm can discover patterns of longer lengths and higher supports. It uses suffix array to store suffixes and sorted in lexicographic order. [13] Proposed an algorithm for finding frequent approximate sequential patterns. It uses hamming distance model and break-down-and-build-up methodology.

III. PROBLEM DEFINITION

In this paper we have presented a method to efficiently mine all frequently occurring approximate substring. Many challenges arise in sequential mining such as projection and prefix extension techniques need more space. Another challenge is allow some noise in matching process because every substring needs to compare with other substring for checking mismatches. We want to find the instances of the pattern in the presence of noise but we do not want that it matches unrelated subsequences which may have large number of mismatches. The input sequence database is composed of symbols from a finite discrete alphabet set. In the case of time series database, it can be converted into a sequence database. Time series database can be converted into a sequence database. Let Σ denote the finite discrete alphabet set. An input sequence S is ordered list of items or events. For example, S is a DNA Sequence over $\{A, C, G, T\}$. The i -th item of a sequence S can be denoted as $S[i]$. Consider two substrings p and q of S having same length n . The hamming distance $d(p,q)$ of two strings p and q is the number of mismatching characters [12].

$$d(p, q) = |I|$$

$$I = \{i \mid p_i \neq q_i, 1 \leq i \leq n\}$$

In this model, two strings are considered approximately the same if and only if they are of equal length and their distance is less than or equal to a user specified distance. Here we are considering the (L, d, k) model for discovering patterns, In this model L denotes the length of the frequent pattern string, d denotes the maximum number of mismatches i.e. hamming distance between pattern string and instance of that string and k denotes the minimum support that is minimum number of instances of pattern in input sequential database. Such model is commonly used for finding DNA motif in computational biology. Proposed approach outputs the model strings that had sufficient support that is the support is greater than or equal to predefined k .

IV. PROPOSED METHOD

In this section, we present a new method for discovering frequent approximate sequences that can be used for pattern mining. Throughout this section, we will assume that the input sequence i.e. dataset is composed of symbols from a discrete alphabet set and outputs the model strings that had sufficient

support along with its all instances. We have proposed method for model (L, d, k) and tried to improve the performance of existing algorithm presented in [8]. In model (L, d, k) , L is the length of the pattern, d is the maximum distance within which two strings are considered similar and k is the minimum support or frequency required for a valid patterns. In proposed method we are considering only those strings of length L that actually occur in the dataset and compute the support for each of them by scanning the dataset. This approach will not discover patterns as the model string might not actually occur in the dataset even once.

Input:

1. Input sequence is composed of symbols from a discrete alphabet sets.

Set of items/alphabets $I = \{a_1, a_2, \dots, a_m\}$

Input Sequential database $D = \{x \mid \forall x \in I\}$

E.g. $I = \{A, B, C, D\}$

$D = ACABBDACCAB$

2. Values of L, d and k .

Where

L : Length of substring

d : Distance/number of mismatches allowed

k : Minimum Support

Output:

Set of (L, d, k) model Strings.

$Op = \{s_1, s_2, \dots, s_n\}$

Where

$Si = \{si_1, si_2, \dots, si_m\}$ is set of instances for si .

$Op = \{si \mid d(si, sij) \leq d, |sij|=L \text{ and } m \geq k\}$

System:

FreqPattern(mTree, root, L, d, k)

1. process();
2. getmodelTree();
3. For $i=0$ to $i < mTree.size()$
4. computeSupport();
5. End For

process()

Construct count suffix tree on input dataset.

getmodelTree()

Construct suffix tree of depth L on strings of length L that occurs in the count suffix tree.

computeSupport()

1. oldMatches=model.parent.matches;
2. if(model.parent.id=1)
3. newMatches=expandMatches()
4. else
5. for $k=0$ to $k < oldMatches.size()$
6. newMatches.addAll(expandMatches())
7. End for
8. setMatches(newMatches)
9. for $i=0$ to modelTree.size()
10. $x=modelTree.get(i)$
11. if(distance() $\leq d$)
12. model.matches.add(x)
13. model.modelSupport +=x.support;

```

14. End for
15. End
    
```

Fig. 1. Pseudocode for proposed method.

Frequently occurring pattern of model (L, d, k) a string of length L that occurs minimum k times in the input dataset, with each occurrence being within a Hamming distance of d from the model string. Hamming distance between strings S and P is shown in fig. 1 from [12].

S = AABCACDCABCD
P = AAC CABDCABCD

Fig. 2. Hamming Distance between string S and P are 2

In this example Fig. 2 hamming distance between string S and P is 2 (area which is not highlighted). We first construct a count suffix tree on the actual dataset. Then construct a model suffix tree on those strings of length L that actually occurs in the dataset i.e. model tree is constructed for count suffix tree. The pseudo code of proposed method is given in Fig. 1. The method process() construct the count suffix tree on input dataset, which helps to quickly compute the support. Method getModelTree() construct the model suffix tree from count suffix tree, which is of depth L on set of strings of length L. The pruning strategy is similar as explained in FLAME[8]. All the strings of length L starting with the same symbol makes one partition. This partition corresponds to all the nodes in the model suffix tree under the subtree corresponding to same node. These partitions continue on for L levels, and at the last level, we have only one model string for each partition. At each node in the model suffix tree, the routine computeSupport() is called, which computes the list of matches and the new support. At any node, if algorithm finds that support is lower than k, it prunes away that that subtree in the model suffix tree, and if it finds a model of length L with the required support, it outputs the result in the form shown in Fig. 3 below.

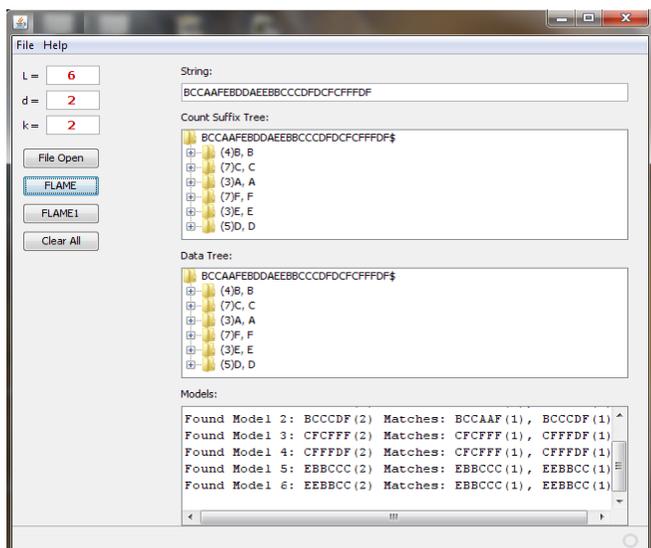


Fig. 3. Graphical User Interface.

V. EVALUATION

In this section, we compare proposed method with FLAME algorithm. We present results from various experiments to test the effectiveness and performance of proposed method.

Comparison with FLAME algorithm

We compare FLAME and proposed method by performing a typical (L,d,k) motif mining task on DNA datasets. We vary the length of sequences from 200 to 1200 symbols. Both algorithms try to find (L,d,20) motifs for d=1,2 and L varying from 6 to 8. For the task of finding motifs with L varying from 6 to 8, and d=1 (denoted as (6-8,1,20) in Figure 4), the FLAME algorithm works well for small database sizes. However, as the database size increases, we see that its performance begins to decrease. For the (6-8,2,20) task, FLAME takes larger time to complete sequence lengths beyond 600. Proposed method takes relatively very less time as compare to FLAME algorithm.

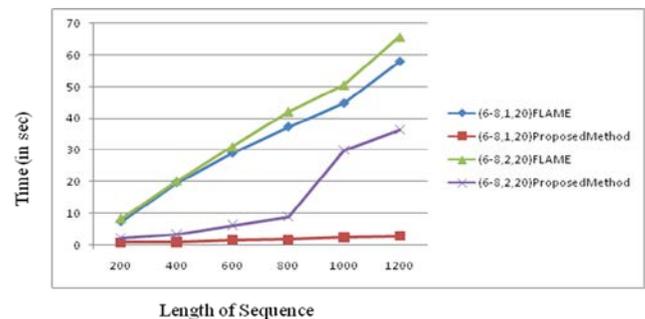


Fig. 4 FLAME vs Proposed Method for varying database sizes

Proposed method is a simple algorithm that finds all patterns that appears more frequently than expected. In proposed method, model tree is constructed from data tree i.e. considering only those strings of length L that actually occur in the dataset. FLAME algorithm builds model tree on all possible model string so it discovers large number of patterns than proposed method. We demonstrate this behavior using a synthetic dataset containing 12800 symbols long. We run FLAME and proposed method on a variety of (L,d,k) models. The results of this experiment are presented in Fig. 5.

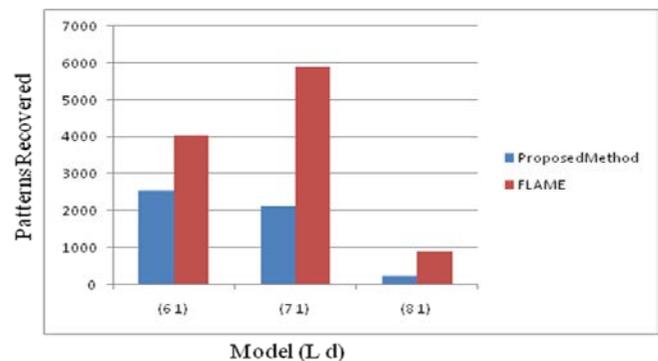


Fig. 5 FLAME vs Proposed Method for number of patterns recovered.

Test Report:

This approximate subsequence mining problem is of particular importance in computational biology, where the challenge is to detect short sequences, usually of length 6-15, that occur frequently in a given set of DNA or protein sequences. In this white box testing, we check system works for lengths 6-15.

Mining Time Series Data: We study the performance of proposed method for different parameters of the (L, d, k) model. In this experiment we use (L,d,k) model to mine the stock price dataset. We have decided the ranges and then assigned a symbol to each range and encoded the numerical series into a symbolic sequence. The dataset totaled about 9331 symbols. We present the time taken by proposed method to find several (L,d,k) models.

We run proposed method for L=5,8,11 and 14, while varying the distance d and support 21. The results of this experiment are shown in Fig. 6. We observe from the figure that as the distance is increased the time taken to execute the search increases. Proposed method is able to find models of length 14 within 15118 ms.

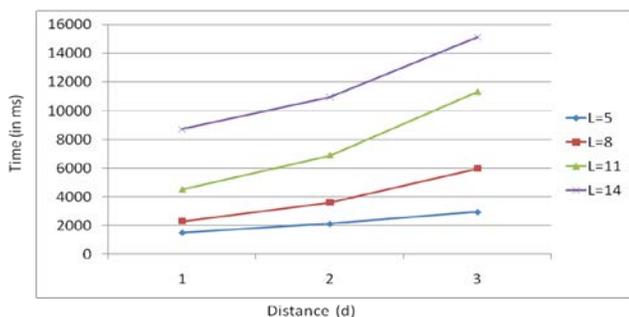


Fig. 6 Proposed Method: Distance vs time taken on stock price data.

VI. CONCLUSIONS

Proposed method will discover frequent approximate patterns of model (L, d, k). (L,d,k) model is a string of length L that occurs k times in the dataset, with each occurrence being with a Hamming distance of d from the model string. The dataset and the values of L, d, and k are specified as input.

System first construct two suffix trees: a count suffix tree on the actual dataset and a suffix tree on the set of all possible model strings present in count suffix tree. The model suffix tree is typically the set of all string of length L from count suffix tree. Count suffix tree is merely a suffix tree in which every node contains the number of leaves in the subtree rooted at that node. The difficulty in discovering frequent patterns is to allow for some noise in the matching process. It's most common applications are discovery of subsequences in DNA sequences, financial industry use data mining to identify interesting share price movements, the analysis of web log for web usage, customer shopping sequences and the investigation of scientific or medical processes and so on. The results of pattern mining can be used by business management for marketing, planning and prediction.

A series of experiments on real and synthetic datasets, we demonstrate that proposed method can be used in several real pattern mining tasks. Proposed method is significantly faster than FLAME. We also presented experiments which show that proposed method discover patterns actually occur in the dataset but FLAME discover patterns that might not actually occur in the dataset even once.

VII. FUTURE ENHANCEMENT

Proposed method discovers patterns of (L,d,k) model where L is length of pattern, d is maximum distance and k is minimum distance. Sometimes the exact length of the pattern is not known but has a rough idea of the range in which it may lie. One often ends up trying several (L,d,k) values such as (6-15, 2, 20), (6-16,1,15) etc. Thus future scope in this dissertation is to add functionality for discovering such patterns.

REFERENCES

- [1] V. Kamble, Emmanuel M and A. Phakatkar, "Novel Approach for Discovery of Frequently Occurring Approximate Sequences," ICCA Conference, 2012.
- [2] J. Wang and J. Han, "BIDE: Efficient Mining of Frequent Closed Sequences," in ICDE, 2004, pp. 79-90.
- [3] X. Yan, J. Han, and R. Afshar, "CloSpan: Mining Closed Sequential Patterns in Large Datasets," in SDM, 2003.
- [4] M. J. Zaki, "Sequence Mining in Categorical Domains: Incorporating Constrains," in CIKM, 2000, pp. 442-429.
- [5] J. Pei, J. Han, and W. Wang, "Mining Sequential Patterns With Constraints in Large Databases," in CIKM, 2002, pp. 18-25.
- [6] J. Han, and M. Kamber, Data Mining Concepts and Techniques. Morgan Kanufmann, 2000.
- [7] J. Pei, J. Han, B. Mortazavi-Asl, H. Pinto, Q. Chen, U. Dayal, and M. Hsu, "PrefixSpan: Mining Sequential Patterns by Prefix-Projected Growth," in ICDE, 2001, pp. 215-224.
- [8] R. Nizar, Mabroukeh and C.I. Ezeife, "A taxonomy of sequential pattern mining algorithms," ACM Comput. Surv. 43, 1, Article 3, 2010.
- [9] A. Floratou, S. Tata and J. M. Patel, "Efficient and Accurate Discovery of Patterns in Sequence Data Sets," IEEE Trans. Knowledge and Data Engineering, vol. 23, pp. 1154-1168, Aug. 2011.
- [10] R. Agrawal and R. Srikant. Mining sequential patterns. In proc. 1995 Int. Conf Data Engineering (ICDE'95), pages 3-14, Taipei, Taiwan, Mar. 1995.
- [11] M. J. Zaki, "SPADE: An Efficient Algorithm for Mining Frequent Sequences," Machine Learning, vol. 42, no. 1/2, pp. 31-60, 2001.
- [12] J. Yang, W. Wang, P. S. Yu, and J. Han, "Mining Long Sequential Patterns in a Noisy Environment," in SIGMOD, 2002, pp. 406-417.
- [13] X. Ji and J. Bailey, "An efficient technique for mining approximately frequent substring patterns," Seventh IEEE International Conference on Data Mining, pp. 325-330, 2007.
- [14] F. Zhu, X. Yan, J. Han and P. Yu, "Efficient Discovery of Frequent Approximate Sequential Patterns," Seventh IEEE International Conference on Data Mining ICDM, pp. 751-756, Oct. 2007.
- [15] V. Makinen and G. Navarro, "Compressed Compact Suffix Arrays," in Proc. Of Combinatorial Pattern Matching (CPM), vol. 3109 of Lecture Notes in Computer Science, 2004.

AUTHORS

First Author – Ms. V. V. Kamble, COEP Pune, India
Second Author – Mr. S. V. Kamble, Flora Institute of Technology, Pune, India

A review on Advanced Desktop computer

VivekchandKharwar, MukeshPatel, SunnyNahar

V.E.S Institute of Technology, Approved by AICTE & Affiliated to Mumbai University, Hashu Advani Memorial Complex, Collector colony, Chembur-400074.

Abstract- A new concept of pc is coming now that is **Advanced Desktop computer** Concept pc. The **Advanced Desktop computer** is a sphere shaped computer concept which is the smallest design among all the laptops and desktops have ever made. This PC concept features all the traditional elements like mouse, keyboard, large screen display, DVD recorder, etc, all in an innovative manner. Advanced Desktop computer is designed to be placed on two stands, opens by simultaneously pressing and holding the two buttons located on each side. After opening the stand and turning ON the PC, pressing the detaching mouse button will allow you to detach the optical mouse from the PC body. This concept features a laser keyboard that can be activated by pressing the particular button. Advanced Desktop computer is very small, it is having only 6 inch diameter sphere. It is having 120×120mm motherboard.



I. INTRODUCTION

EBall concept pc don't have any external display unit, it has a button when you press this button a projector will pop and it focus the computer screen on the wall which can be adjusted with navigation keys. If there is no wall then it has a paper sheet holder that divides into three pieces like an umbrella just after popping up, and it will show desktop on the paper sheet. Also, the

Advanced Desktop computer PC supports a paper holder and the paper sheet on the holder could act like a screen where you can watch movies or something. This concept PC will measure 160mm in diameter and it was designed for Microsoft Windows OS.

Features of Advanced Desktop computer:

- It contains wireless optical mouse and laser keyboard, and LCD projector.
- It has around 350-600GB of Hard Disk Drive.
- It contains 5GB RAM.
- It has two 50W speakers.
- It has LAN and WLAN card and a Web cam.

Elements of Advanced Desktop computer

Aren't you tired of your PC? By his ugly shape and the way that it looks? Well, this is exactly what designer Apostol Tnokovski was feeling when he decided to create the smallest PC ever made. It's not going to be like a PDA, it's going to be a PC with all conventional components (mouse, keyboard, normal screen). The concept PC is called Advanced Desktop computer and it's shaped like a sphere because in Tnokovski's opinion this is the best shape in nature and it draws everybody's attention.



When you want to carry it around you can easily "pack it" into a ball. This is a futuristic concept, and this, I think, is how

the future computers will look like. This device has an optical keyboard and a holographic display. So you don't have a physical keyboard and no monitor! Still, the mouse is physical but it fits in to the computer when you want to carry it around. The bad thing about using a virtual keyboard is that you need a smooth surface; otherwise I don't know how you will be able to use it. It is strange enough to call this device a computer, because it is so small, but as far as I know it doesn't lack any hardware part and tends to be a future machine found in any house or office.

Working of Advanced Desktop computer:

E Ball concept pc don't have any external display unit, it has a button when you press this button a projector will pop and it focus the computer screen on the wall which can be adjusted with navigation keys. If there is no wall then it has a paper sheet holder that divides into three pieces like an umbrella just after popping up, and it will show desktop on the paper sheet. Also, the Advanced Desktop computer PC supports a paper holder and the paper sheet on the holder could act like a screen where you can watch movies or something. This concept PC will measure 160mm in diameter and it was designed for Microsoft Windows OS, sorry about the others. For the moment there is no word on pricing or when it's going to be available, however, I am sure that everybody would like to see a small spherical PC like this one.



Advanced Desktop computer concept pc has a laser keyboard that is fully a concept keyboard that is visible when the pc is in working. The keyboard is not physical - it is interpreted by lasers that appear after you press the respective button. It recognizes your fingers with the help of an IR sensor when you are typing at a particular place, while the mouse is a pop out wonder making this an existing piece of technology.

Advanced Desktop computer concept pc work very easy while you are making video presentations, listening music watching large screen movies, and chatting on the net.

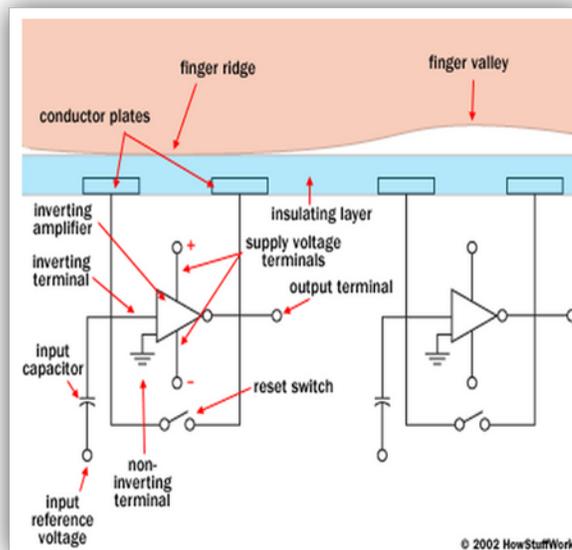
Security issues:

Suppose some intruder wants to get access to my Advanced Desktop computer, he/she can easily access it. To avoid it you can set-up user account. It is secure if the system is not movable or it has no chance of lost. But as we know, Advanced Desktop computer is portable there are chances of being stolen. In that case if you want not to allow others accessing you system, you don't have any feature.

So, to overcome with these security issues what I decide is to integrate the finger-print scanner with Advanced Desktop computer.

The finger-print scanner can be integrating inside the Advanced Desktop computer or we can use mouse which has an in-built finger-print scanner.

This is how finger-print scanner works:



The finger-print scanner in-built mouse looks like this:



To integrate it into Advanced Desktop computer we can use following devices.



Advanced Desktop computer with Scanner:

Advanced Desktop computer displays the content on the wall or the paper. But it does not provide any facility to scan the documents, so have to look for scanner. Scanner is very important components it allows to get documents ready as softcopy. To allow the Advanced Desktop computer can provide these features without requiring any extra hardware component. To overcome this limitation we can use scanner with it. But as we know that the main aspect of Advanced Desktop computer is to reduce the size and weight of traditional computer.

So, considering the weight and size of Advanced Desktop computer I have something new. It is called MadMapper. The MadMapper provides a simple and easy tool for video-mapping projections and LED mapping. It removes a lot of the confusion related to this medium, effectively demystifying the process, allowing you, the artist or designer to focus on creating your content, and making the experience of mapping textures to physical objects in real time, fun.

Advantages of Advanced Desktop computer:

- It is portable.
- Advanced Desktop computer has large memory.
- Useful for making video presentations.
- These have greater speed.
- Supports user-defined keyboard layouts
- Build-in projector- scanner support.
- Finger-print authentication.

Disadvantages of Advanced Desktop computer:

- Cost of Advanced Desktop computer is very high.

REFERENCES

- [1] <http://www.google.co.in/EBALL>
- [2] <http://www.electronics.howstuffworks.com>
- [3] <http://www.madmapper.com>
- [4] <http://www.secugen.com/products/po.htm>
- [5] <http://www.mantratec.com/fingerprint-mouse-biometric-mouse-computer-india.html>

AUTHORS

First Author – Vivek chand Kharwar, V.E.S Institute of Technology, Approved by AICTE & Affiliated to Mumbai University, Hashu Advani Memorial Complex, Collector colony, Chembur-400074, Email: vivekchand_k@yahoo.com

Second Author – Mukesh Patel, V.E.S Institute of Technology, Approved by AICTE & Affiliated to Mumbai University, Hashu Advani Memorial Complex, Collector colony, Chembur-400074, Email: muksapatel@gmail.com

Third Author – Sunny Nahar
V.E.S Institute of Technology, Approved by AICTE & Affiliated to Mumbai University, Hashu Advani Memorial Complex,

Collector colony, Chembur-400074, Email:
sunny.nahar@ves.ac.in

Patient Safety Culture across Hospital in South Sulawesi Province, Indonesia: Comparing Between Urban, Sub Urban and Rural Areas

Irwandy, Syahrir A.Pasinringi, Noer Bahry Noor, Annisa Faradina A, Andi Silviyah, Nurandini Pratiwi, Nurul Athifah A.

Hospital Management Department, Public Health Faculty, Universitas Hasanuddin, Indonesia

Abstract- It is believed that in order to reduce the number of adverse events, hospitals have to stimulate a more open culture and reflective attitude towards errors and patient safety. The objective of this study was to compare the patient safety culture in South Sulawesi Province hospital in urban, sub urban and rural areas.

This study was a cross-sectional survey study. A questionnaire adapted form Agency for Healthcare Research and Quality (AHRQ). The study was conducted in 4 hospital (2 hospitals in urban, 1 in the sub urban and 1 in rural areas). Total respondents was 841 people.

The study found there were differences between patient safety culture in urban, sub urban and rural areas. Number of safety respond was higher at urban hospital (mean=79,5%), sub urban hospital (mean=75%) and the lower at rural hospital (mean=36,2%). The management support for patient safety is the lowest dimension in every hospital.

The study showed the similarities and differences in sub dimension of patient safety culture between hospitals. All hospital can improve their patient safety culture by sharing they best practices and learn from each other.

Index Terms- Patient safety, Culture, Hospital, Indonesia

I. INTRODUCTION

Patient safety is a critical component to the quality of health care. Patient safety is defined as ‘the prevention of harm caused by errors. One-fifth of the people in the community are exposed to medical mistakes¹, and this rate may be as high as 35–42%². As a result, millions of people may die or suffer injuries due to preventable medical errors.

Many experts on patient safety believe that full disclosure of adverse events, without blame, leads to a reduction in medical errors³. Still, in many organizations, there is a blame culture in which health-care professionals are afraid of reporting errors because of liability concerns or the fear of being seen as incompetent by colleagues⁴.

One of the recommendations of the Institute of Medicine in the USA, the Department of Health in the UK and a consortium of field parties (e.g. associations of nurses, doctors and hospitals) in the Netherlands to reduce adverse events is to stimulate a more open culture and reflective attitude towards errors and adverse events⁴.

Patient safety culture can be described as: *The product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization’s health and safety management*^{5,6}.

In Indonesia, the number of patient safety Incidence in 2010 were higher found in local government hospital (16%) rather than in private hospital (12%)⁷. In 2011, the number of patient safety incidence were increasing from January (0,0%), February (3,9%), March (5,15%) and in April (26,76%)⁸.

Structural characteristic of hospital such as (teaching status, size, staffing level and location: rural/urban) will be related with process of care and adverse event which it related to patient safety culture in hospital⁹. The previous research by Singer et.al also give some recommendation to further research to assess the relationship between safety culture and hospital characteristics¹⁰. Comparing organizations in a variety of hospital characteristics such as location would provide important knowledge to learn from each other.

This research objective was to compare the patient safety culture in South Sulawesi Province hospital in urban, sub urban and rural areas. The following are the research questions of this article: (i) what is the patient safety culture in hospitals in the three areas? (ii) Are there any differences across these areas and how can these differences be explained?

II. MATERIAL AND METHOD

This research used cross sectional survey method. The survey was designed to assess opinions of hospital staff about patient safety issues, medical error and event reporting and includes 42 items measuring 12 dimensions of patient safety culture. Questionnaire adopted from the Agency of Healthcare Research and Quality (AHRQ)¹¹. The questionnaire of AHRQ were translated into bahasa by one translator with background in patient safety research.

Respondents are asked to rate each item of a dimension on a four-point Likert scale of agreement (strongly disagree, disagree, agree and strongly agree) or frequency (never, rarely, most of the time, always). The study was conducted in 4 hospital (2 hospitals in urban, 1 in the sub urban and 1 in rural areas).

Total respondents was 841 people with Random sampling was used to survey a wide range of hospital staffs including physicians representing each department, nurses representing each clinical nursing unit, and non-clinical staff.

III. RESULTS

Patient safety culture is a complex framework which involves different dimensions that guides many discretionary behaviors of patient safety. According to the Agency of Healthcare Research and Quality (AHRQ), patient safety culture

requires an understanding of the values, beliefs, and norms about what is important in an organization and what attitudes and behaviors related to patient safety are supported, rewarded, and expected¹¹. Therefore, it is important for health care organizations to assess their culture regarding patient safety in order to improve patient safety within the health care process.

Table 1. Characteristics of respondents

Variable	Sub Variable	n (841)	%
Sex	Male	260	30,9
	Female	581	69,1
Age's	<=20	5	,6
	21 - 30	379	45,1
	31 - 40	300	35,7
	41 - 50	122	14,5
	>50	35	4,2
Unit	Ambulatory	10	1,2
	Pharmacies	70	8,3
	Physiotherapist	17	2,0
	Intensive Care Unit	42	5,0
	Emergency Unit	63	7,5
	CSSD/Laundry	21	2,5
	Nutritionist	58	6,9
	Inpatient Unit	279	33,2
	Outpatient Unit	134	15,9
	Maintenance Unit	11	1,3
	Operating Room	42	5,0
	Laboratory	27	3,2
	Radiology	26	3,1
	Medical Records	41	4,9

Table 2. Comparative results on safety culture dimensions of three areas

Safety culture dimensions	Percentage Positive Responses		
	Urban	Sub Urban	Rural
Teamwork Within Units	96,1%	59,2%	99,0%
Supervisor/Manager Expectations & Actions Promoting Patient Safety	90,0%	78,0%	44,3%
Organizational Learning—Continuous Improvement	81,6%	71,8%	43,8%
Management Support for Patient Safety	58,4%	59,1%	6,9%
Overall Perceptions of Patient Safety	71,9%	76,7%	67,0%
Feedback & Communication About Error	61,9%	94,7%	35,3%
Communication Openness	83,7%	85,9%	10,8%
Frequency of Events Reported	80,0%	96,4%	9,0%
Teamwork Across Units	93,7%	83,7%	48,2%
Staffing	84,4%	63,9%	11,5%

Handoffs & Transitions	81,2%	67,8%	48,4%
Non-punitive Response to Errors	70,8%	62,9%	10,5%
Mean	79,5%	75,0%	36,2%
Max	96,1%	96,4%	99,0%
Min	58,4%	59,1%	6,9%

The results of this survey divided at three different levels: the unit level, the hospital level, and the outcome level.

Unit-level aspects of patient safety culture

The unit unit-level aspects of safety culture are divided into 7 sub dimensions in table 1 such as: Supervisor/ manager expectations and actions promoting safety (4 items), Organizational learning-continuous improvement (3 items), Teamwork within units (4 items), Communication openness (3 items), Feedback and communication about error (3 items), Non-punitive response to error (3 items), Staffing (4 items).

For the "Supervisor/manager expectations and actions promoting safety" dimension, the percentage of positive responses for Hospital in Urban Area is 96,1%, which is much higher than hospital in hospital in sub urban and rural areas was the lower.

The percentage of positive responses for "Teamwork within units" is 99% in rural area, which is much higher than in hospital at Urban and Sub Urban. The results indicate that most of the respondents in this study feel supportive and respected in their unit or work place, and they are more likely to cooperate and coordinate with their co-workers.

For the Organizational learning-continuous improvement and non-punitive response to error dimensions, the percentage of positive responses are higher in urban hospitals and lower at hospital in rural area. However for the Communication openness and Feedback and communication about error the percentage of positive responses were higher at sub urban hospitals.

Hospital-level aspects of patient safety culture

The hospital-level aspects of patient safety culture sub dimension items in table 1 are hospital management support for patient safety (3 items), teamwork across hospital units (4 items) and hospital handoffs and transitions (4 items). The "Hospital management support for patient safety" dimension is an indication of whether the management team provides a work climate that promotes patient safety¹².

The higher percentage of positive response of hospital management support for patient safety found at hospital in sub urban area. For teamwork across hospital units and hospital handoffs and transitions dimensions were higher in hospital in urban area. Overall, three dimension of hospital level at hospital in rural area showed the lowest number of positive respond rather than other areas.

Outcome-level aspects of patient safety culture

The outcome-level measurements of patient safety culture include "Overall perceptions of safety" and "Frequency of event reporting" (items 5 and 8 in Table 1). Overall perception of patient safety culture is an indication of good procedures and

systems for preventing errors and the lack of patient safety problems. The percentage of positive response for sub urban hospital for this item is 76,7%, a little higher than in the urban hospital result (71,9%). For the frequency of event reporting factor, the positive response also higher in sub urban hospital rather in urban and rural areas.

Overall patient safety culture

Based on table 1, we can see for overall the percentage of positive respond rate of patient safety culture in three area were higher in urban area (79,5%) following in sub urban area (75%) and in rural area was lower (36,2%).

IV. DISCUSSION

The Hospital Survey on Patient Safety Culture is one of the most common tools being used to assess the culture of safety in hospitals. Studies that utilize this tool usually report the 12 composite scores and the scores on the patient safety grade and the number of events reported.

Based on the 12 culture dimensions of patient safety culture, the results showed that Teamwork within units is a strong area in the participating hospitals in rural (99%) and urban areas (96,1%). A similar finding was reported by C. Wagner, et.al in 2013 was survey the hospital in three countries (Netherlands, USA and Taiwan)⁴. They found that Teamwork within units is a strong area in hospital in three countries. It means patient safety culture always growth firstly in units and for improve the patient safety culture we have to give more attention in that areas.

Hospital size and accreditation status were also factors affecting the culture of safety in hospitals¹³. Most of hospital in rural area is a small hospital. Small hospitals scored higher than larger hospitals on Teamwork within units. Large hospitals usually face challenges when it comes to implementing quality work especially because of bureaucracy. On the contrary, small hospitals have a more homogenous culture where staff members are more likely to share the same values¹³.

For hospital in sub urban the strong area found in the Frequency of Events Reported. A safety culture includes three major components a just culture, a reporting culture, and a learning culture¹¹. Event reporting, an essential component for achieving a learning culture, can only happen in a non-punitive environment where events can be reported without people being blamed¹⁴.

This research also found that in all three areas is the Management Support for Patient Safety are the lower sub dimension. The hospital has to give more attention for improving their management support for patient safety because the safety culture will be hard to grow and sustain if did not get support from the management.

V. CONCLUSION

Developing a patient safety culture was one of the recommendations made by the Institute of Medicine to assist hospitals in improving patient safety. Assessing the organization's existing safety culture is the first stage of developing a safety culture¹⁵.

Doing comparisons on hospital safety culture can help us to identify opportunities for improving an important area for research with potentially useful implications for practice. The results have shown similarities and differences within and between the three areas. This means that hospitals with low scores on safety culture dimensions can learn from hospitals that have more developed safety cultures.

Good examples can be found within each areas, reducing the necessity to look over the borders when it comes to improving safety culture. However, for some dimensions with low scores, hospital can share best practices and learn from each other. For various weak points, safety improvement activities already exist and exchange of experiences with the implementation of these activities can take place.

ACKNOWLEDGEMENTS

The authors wish to thank the hospitals and staff that participated in the survey.

REFERENCES

- [1] Adams RE, Boscarino JA. A community survey of medical errors in New York. *Int J Qual Health Care* 2004;16:353–62.
- [2] Blendon RJ, DesRoches CM, Brodie M et al. Views of practicing physicians and the public on medical errors. *N Engl J Med* 2002;347:1933–40.
- [3] Kohn LT, Corrigan JM, MS D. *To Err Is Human: Building a Safer Healthcare System*. Washington DC: National Academy Press; 2000.
- [4] Wagner C, Smits M, Sorra J, Huang CC. Assessing patient safety culture in hospitals across countries. *International Journal for Quality in Health Care* 2013. 2013; Volume 25(Number 3):pp. 213–21.
- [5] Health and Safety Commission (HSC). *Organizing for Safety: Third Report*. ACSNI Study Group on Human Factors: Sudbury: HSE Books; 1993.
- [6] Nieva V, Sorra J. Safety culture assessment: a tool for improving patient safety in health care organizations. *Qual Saf Health Care*. 2003;12 (Suppl. II):ii17–23.
- [7] Patient Safety Hospital Committee. *Patient Safety Incidence Report in Indonesia*. Jakarta: KKP-RS, 2010.
- [8] Patient Safety Hospital Committee. *Patient Safety Incidence Report in Indonesia (Period:Jan-April)*. Jakarta: KKP-RS, 2011.
- [9] Rivard PE, Christiansen CL, Zhao S, Elixhauser A, Rosen AK. *Is There an Association Between Patient Safety Indicators and Hospital Teaching Status?* Boston: Center for Organization, Leadership and Management Research, VA Boston Healthcare System, 2008.
- [10] Singer S J, Gaba D M, Geppert J J, Sinaiko A D, Howard S K, Park K C. The culture of safety: results of an organization-wide survey in 15 California hospitals. *Qual Saf Health Care*. 2003;12:112–118.

- [11] Association of Healthcare Research and Quality. Available from: <http://www.ahrq.gov/qual/hospsurveydb/index.html>.
- [12] Chen, C. and H.-H. Li (2010). "Measuring patient safety culture in Taiwan using the Hospital Survey on Patient Safety Culture (HSOPSC)." *BMC Health Services Research* 10:152.
- [13] El-Jardali. *The impact of hospital rationalization and the interrelationships among organizational culture and nursing care processes on health related patient outcomes*. PhD thesis Canada: Carleton University; 2003.
- [14] Smits M, Christiaans-Dingelhoff I, Wagner C, Wal G, PP G. The psychometric properties of the "Hospital Survey of Patient Safety Culture" in Dutch hospital. *BMC Health Services Research* 2008;8.
- [15] Hellings J, Schrooten W, Klazinga N, A V. Challenging patient safety culture: survey results. *International Journal of Health Care Quality Assurance* 2007. 2007; 20:620-632.

AUTHORS

First Author – Irwandy, Hospital Management Department , Faculty of Public Health , Hasanuddin University, Jl. Perintis Kemerdekaan Km.10 Hasanuddin University Campus, Tamalanrea, Makassar, Indonesia.

Second Author – Syahrir A. Pasinringi, Hospital Management Department , Faculty of Public Health , Hasanuddin University, Jl. Perintis Kemerdekaan Km.10 Hasanuddin University Campus, Tamalanrea, Makassar, Indonesia.

Third Author – Noer Bahry Noor, Hospital Management Department , Faculty of Public Health , Hasanuddin University, Jl. Perintis Kemerdekaan Km.10 Hasanuddin University Campus, Tamalanrea, Makassar, Indonesia

Fourth Author - Annisa Faradina A, Hospital Management Department , Faculty of Public Health , Hasanuddin University, Jl. Perintis Kemerdekaan Km.10 Hasanuddin University Campus, Tamalanrea, Makassar, Indonesia

Fifth Author - Andi Silviyah, Nurandini Pratiwi¹, Nurul Athifah Hospital Management Department , Faculty of Public Health , Hasanuddin University, Jl. Perintis Kemerdekaan Km.10 Hasanuddin University Campus, Tamalanrea, Makassar, Indonesia

Sixth Author - Nurandini Pratiwi¹, Hospital Management Department , Faculty of Public Health , Hasanuddin University, Jl. Perintis Kemerdekaan Km.10 Hasanuddin University Campus, Tamalanrea, Makassar, Indonesia

Seventh Author - Nurul Athifah, Hospital Management Department , Faculty of Public Health , Hasanuddin University, Jl. Perintis Kemerdekaan Km.10 Hasanuddin University Campus, Tamalanrea, Makassar, Indonesia

Correspondence Author; Irwandy
Email Address: wandy_email@yahoo.co.id

Secured Data Outsourcing in Cloud Computing

Rajendra N. Kankrale*, Mahendra B. Gawali

IT Dept, SRES COE, SPPU, Pune.

Abstract- Cloud computing has gained a lot of publicity in the current IT world. After the internet, Cloud computing is the next big thing in the computer world. Cloud computing is the use of the Internet for the tasks performed on the computer and it is the next-generation architecture of IT Industry. Cloud computing is related to different technologies and the convergence of various technologies has emerged to be called cloud computing. Cloud Computing moves the application software and databases to the large data centers, where the management of the data and services may not be fully trustworthy. This unique attribute, however, poses many new security challenges which have not been well understood. In this paper, we discuss the design mechanisms that not only protect sensitive data with encrypted data, but also protect customers from malicious behaviors by enabling the validation of the computation result.

Index Terms- Cloud Computing, SaaS, PaaS, IaaS, EC2

I. INTRODUCTION

Cloud computing is the use of computing resources (hardware and software) that are delivered as a service over a network (typically the Internet). The name comes from the use of a cloud-shaped symbol as an abstraction for the complex infrastructure it contains in system diagrams. Cloud computing entrusts remote services with a user's data, software and computation. Cloud computing is a general term for anything that involves delivering hosted services over the Internet. A Cloud service has three distinct characteristics that differentiate it from traditional hosting. It is sold on demand, typically by the minute or the hour; it is elastic - a user can have as much or as little of a service as we want at any given time; and the service is fully managed by the provider. A Cloud can be private or public. A public cloud sells services to anyone on the Internet. Currently, Amazon Web Services is the largest public cloud provider [6].

From the perspective of data security, which has always been an important aspect of quality of service, Cloud Computing inevitably poses new challenging security threats for number of reasons. First security threat is the traditional cryptographic primitives for the purpose of data security protection cannot be directly adopted due to the users' loss control of data under Cloud Computing[2]. Therefore, verification of correct data storage in the cloud must be conducted without explicit knowledge of the whole data. Considering various kinds of data for each user stored in the cloud and the demand of long term continuous assurance of their data safety, the problem of verifying correctness of data storage in the cloud becomes even more challenging. Another security threat is the data stored in the cloud may be frequently updated by the users, including

insertion, deletion, modification, appending, reordering, etc. To ensure storage correctness under dynamic data update is hence of paramount importance[1]. Lastly, the deployment of Cloud Computing is powered by data centers running in a simultaneous, cooperated and distributed manner. Individual user's data is redundantly stored in multiple physical locations to further reduce the data integrity threats. Therefore, distributed protocols for storage correctness assurance will be of most importance in achieving a robust and secure cloud data storage system in the real world. However, such important area remains to be fully explored in the literature. The cloud computing have various service models which are given below.

In this paper, we only focus on the Software as a service. In this model, cloud providers install and operate application software in the cloud and cloud users access the software from cloud clients. The cloud users do not manage the cloud infrastructure and platform on which the application is running. This eliminates the need to install and run the application on the cloud user's own computers simplifying maintenance and support. What makes a cloud application different from other applications is its elasticity. This can be achieved by cloning tasks onto multiple virtual machines at run-time to meet the changing work demand. Load balancers distribute the work over the set of virtual machines. This process is inconspicuous to the cloud user who sees only a single access point. To accommodate a large number of cloud users, cloud applications can be multitenant, that is, any machine serves more than one cloud user organization. It is common to refer to special types of cloud based application software with a similar naming convention: desktop as a service, business process as a service, test environment as a service, communication as a service.

Several trends are opening up the era of Cloud Computing, which is an Internet-based development and use of computer technology. The ever cheaper and more powerful processors, together with the software as a service (SaaS) computing architecture, are transforming data centers into pools of computing service on a huge scale. The increasing network bandwidth and reliable yet flexible network connections make it even possible that users can now subscribe high quality services from data and software that reside solely on remote data centers.

Moving data into the cloud offers great convenience to users since they don't have to care about the complexities of direct hardware management. The pioneer of Cloud Computing vendors, Amazon Simple Storage Service (S3) and Amazon Elastic Compute Cloud (EC2) [5] are both well known examples. While these internet-based online services do provide huge amounts of storage space and customizable computing resources, this computing platform shift, however, is eliminating the responsibility of local machines for data maintenance at the same time. As a result, users are at the mercy of their cloud service

providers for the availability and integrity of their data. Recent downtime of Amazon's S3 is such an example.

From the perspective of data security, which has always been an important aspect of quality of service, In Cloud Computing inevitably poses new challenging security threats for number of reasons. Firstly, traditional cryptographic primitives for the purpose of data security protection cannot be directly adopted due to the users' loss control of data under Cloud Computing. Therefore, verification of correct data storage in the cloud must be conducted without explicit knowledge of the whole data [7]. Considering various kinds of data for each user stored in the cloud and the demand of long term continuous assurance of their data safety, the problem of verifying correctness of data storage in the cloud becomes even more challenging. Secondly, Cloud Computing is not just a third party data warehouse. The users may be frequently update their data which is stored on the cloud. The updating includes insertion, deletion, modification, appending, reordering, etc. To ensure storage correctness under dynamic data update is more important. However, this dynamic feature also makes traditional integrity insurance techniques futile and entails new solutions. Last but not the least, the deployment of Cloud Computing is powered by data centers running in a simultaneous, cooperated and distributed manner. Individual user's data is redundantly stored in multiple physical locations to further reduce the data integrity threats. Therefore, distributed protocols for storage correctness assurance will be of most importance in achieving a robust and secure cloud data storage system in the real world.

The tremendous benefits, outsourcing computation to the commercial public cloud is also depriving customers direct control over the systems that consume and produce their data during the computation, which inevitably brings in new security concerns and challenges towards this promising computing model. On the one hand, the outsourced computation on the cloud server often contain sensitive information, such as the business financial records, proprietary research data, or personally identifiable health information etc[1].

To take action against unauthorized information leakage, sensitive data have to be encrypted before outsourcing. So as to provide end-to-end data confidentiality assurance in the cloud and beyond. However, ordinary data encryption techniques in essence prevent cloud from performing any meaningful operation of the underlying plaintext data, making the computation over encrypted data a very hard problem[1]. On the other hand, the operational details which are done inside the cloud are not transparent to customers. As a result, there do exist various motivations for cloud server to behave unfaithfully and to return incorrect results, i.e., they may behave beyond the classical semi honest model. For example, for the computations that require a large amount of computing resources, there are huge financial incentives for the cloud to be "lazy" if the customers cannot tell the correctness of the output [1]. Besides, possible software bugs, hardware failures, or even outsider attacks might also affect the quality of the computed results.

Thus, we can say that, with respect to the customers point of view the cloud is not secure. Without providing a mechanism for secure computation outsourcing, i.e., to protect the sensitive input and output information on the cloud servers and to validate the integrity of the computation result, it would be hard to expect

cloud customers to turn over control of their cloud servers from local machines to cloud solely based on its economic savings and resource flexibility. For practical consideration, such a design should further ensure that customers perform fewer amounts of operations following the mechanism than completing the computations by themselves directly[1]. Otherwise, there is no point for customers to seek help from cloud. Recent researches in both the cryptography and the theoretical computer science communities have made steady advances in "secure outsourcing expensive computations".

II. LITERATURE SURVEY

According to "Non-interactive verifiable computing: Outsourcing computation to entrusted workers" the author R. Gennaro [4] said that, the work is based on the crucial (and somewhat surprising) observation that Yao's Garbled Circuit Construction, in addition to providing secure two-party computation, also provides a "one-time" verifiable computation. In other words, we can adapted Yao's construction to allow a client to outsource the computation of a function on a single input. More specifically, in the preprocessing stage the client garbles the circuit C according to Yao's construction. Then in the "input preparation" stage, the client reveals the random labels associated with the input bits of x in the garbling. This allows the worker to compute the random labels associated with the output bits, and from them the client will reconstruct $F(x)$. If the output bit labels are sufficiently long and random, the worker would not be able to guess the labels for an incorrect output, and therefore the client is assured that $F(x)$ is the correct output.

According to "Secure outsourcing of sequence comparisons", the author M. J. Atallah said that, we now more precisely stated the edit distance problem, in which the cost of an insertion or deletion or substitution is a symbol-dependent non-negative weight, and the edited distance then the least-cost set of insertions, deletions, and substitutions required to transform one string into the other. More formally, if we let λ be a string of length n , $\lambda = \lambda_1 \dots \lambda_n$ and μ be a string of length m , $\mu = \mu_1 \dots \mu_m$, both over some alphabet Σ . There are three types of allowed edit operations to be done on λ : insertion of a symbol, deletion of a symbol, and substitution of one symbol by another [5]. Each operation has a cost associated with it, namely $I(a)$ denotes the cost of inserting the symbol a , $D(a)$ denotes the cost of deleting a , and $S(a, b)$ denotes the cost of substituting a with b . Each sequence of operations that transforms λ into μ has a cost associated with it and the least-cost of such sequence is the edit-distance. The edit path is the actual sequence of operations that corresponds to the edit distance. According to "Secure outsourcing of scientific computation", the authors M. J. Atallah et. al. said that [9], they produced the first investigation of secure outsourcing of numerical and scientific computation. A set of problem dependent disguising techniques are proposed for different scientific applications like linear algebra, sorting, string pattern matching, etc. However, these disguise techniques explicitly allow information disclosure to certain degree. Atallah et al. discuss in the paper [10] and [11], produced two protocol designs for both secured sequence comparison outsourcing and secured algebraic computation outsourcing. However, both protocols used heavy cryptographic primitive such as

homomorphic encryptions and/or oblivious transfer and do not scale well for large problem set.

In addition, both designs are built upon the assumption of two non-colluding servers and thus vulnerable to colluding attacks. Based on the same assumption, the authors, Hohenberger et al. [3] provide protocols for secure outsourcing of modular exponentiation, which is considered as prohibitively expensive in most public-key cryptography operations. Very recently, Atallah et al. [5] given a provably secure protocol for secure outsourcing matrix multiplications based on secret sharing. While this work outperforms their previous work [11] in the sense of single server assumption and computation efficiency, the main drawback is the large communication overhead. Namely, due to secret sharing technique, all scalar operations in original matrix multiplication are expanded to polynomials, introducing significant amount of overhead. Considering the case of the result verification, the communication overhead must be further doubled, due to the introducing of additional pre-computed "random noise" matrices.

Another large existing list of work that relates to (but is also significantly different from) Secure Multi-party Computation (SMC), first introduced by Yao [11] and later extended by Goldreich et al. [1] and many others. SMC allows two or more parties to jointly compute some general function while hiding their inputs to each other. As general SMC can be very inefficient, Du and Atallah et. al. have proposed a series of customized solutions under the SMC context to a spectrum of special computation problems, such as privacy-preserving cooperative statistical analysis, scientific computation, geometric computations, sequence comparisons, etc. [14]. However, directly applying these approaches to the cloud computing model for secure computation outsourcing would still be problematic. With the major reason is that

Author	Method	Publication Year	Remark
R. Gennaro, C. Gentry, B. Parno[4]	Yao's Grabled Circuit Construction	2010	This technique is not practical due to its huge computation complexity
M. J. Atallah, Jiangtao Li[16]	Simplex Algorithm	2006	Series of interactive cryptographic protocols collaboratively executed in each iteration step.
S. Hohenberger, A. Lysyanskaya[3]	CCA2	2005	The general idea given in this paper is securing outsourcing of modular exponentiation, it is very expensive in public key cryptographic

M. J. Atallah J. Li [10]	Edit Distance Protocol	2005	operation. This protocol efficient for a customer to securely outsource sequence comparisons to two remote agent.
W. Du, J. Jia, M. Mangal, M. Murugesan[17]	Commitment Based Sampling Technique, Merkle Tree based commitment technique	2004	A method of cheating detection for general computation outsourcing in grid computing.
M. J. Atallah, K. N. Pantazopoulos, J. R. Rice, E. H. Spafford[9]	Framework for Disguising scientific computation	2001	The general senario for this method is to design local preprocessing the problem or data before sending to agent and local postprocessing to return exact or true answer.
W. Du, M. J. Atallah[14]	Secure Multi-party Computation (SMC)	2001	Customer knows all input information and thus design efficient result verification mechanism
P. Golle I. Mironov [15]	Generic Distributed Computation	2001	This scheme is very efficient in computation as well as in communication overhead for the participants.

they did not address the asymmetry among the computational powers possessed by cloud and the customers, i.e., all these schemes in the context of SMC impose each involved parties comparable computation burdens, which we specifically avoid in the mechanism design by shifting as much as possible computation burden to cloud only. Another reason is the asymmetric security requirement. In SMC no single involved party knows all the problem input information, making result verification a very difficult task. But in our model, we can explicitly exploit the fact that the customer knows all input information and thus design efficient result verification mechanism.

Recently, Li and Atallah [16] given a study for secure and collaborative computation of linear programming under the SMC framework. Their solution is based on the additive split of the constraint matrix between two involved parties, followed by a series of interactive (and arguably heavy) cryptographic protocols collaboratively executed in each iteration step of the Simplex Algorithm. This solution has the computation asymmetry issue mentioned previously. Besides, they only consider honest-but-curious model and thus do not guarantee that the final solution is optimal.

Detecting the unfaithful behaviors for computation outsourcing is not an easy task, even without consideration of input/output privacy. Verifiable computation delegation, where a computationally weak customer can verify the correctness of the delegated computation results from a powerful but untrusted server without investing too many resources, has found great interests in theoretical computer science community. Some recent general result can be found in Goldwasser et al. In distributed computing and targeting the specific computation delegation of one-way function inversion, Golle et al. [15] proposed to insert some pre-computed results (images of "ringers") along with the computation workload to defeat untrusted (or lazy) workers. In Du. et al. [14] proposed a method of cheating detection for general computation outsourcing in grid computing. The server is required to provide a commitment via a Merkle tree based on the results it computed. The customer can then use the commitment combined with a sampling approach to carry out the result verification (without re-doing much of the outsourced work.) However, all above schemes allow server actually see the data and result it is computing with, which is strictly prohibited in the cloud computing model for data privacy. Thus, the problem of result verification essentially becomes more difficult, when both input/output privacy is demanded. So the duality theory of LP problem and effectively bundles the result verification within the mechanism design, with little extra overhead on both customer and cloud server.

III. CONCLUSION

Here, we study different method for securing the data outsourcing in cloud computing. In secure outsourcing of scientific computation we studied about secure outsourcing of numerical and scientific computation. In secure outsourcing of sequence comparison we studied that two protocol designs for both secure sequence comparison outsourcing and secure algebraic computation outsourcing. In the securely multi-party computation we study the method of cheating detection for general computation outsourcing in grid computing. So all the

method is not fully securing the data outsourcing in cloud computing.

REFERENCES

- [1] C. Wang, K. Ren and J. Wang, "Secure and practical outsourcing of linear programming in Cloud computing", IEEE Transition on cloud computing, pp.820-828, April 2011
- [2] C. Wang, Q. Wang, K. Ren and W. Lou, "Ensuring data storage security in Cloud Computing", in Proc. Of IWQoS'09, July 2009
- [3] S. Hohenberger and A. Lysyanskaya, "How to securely outsource cryptographic computations", in Proc. of TCC, 2005, pp 264-282.
- [4] R. Gennaro, C. Gentry and B. Parno, "Non-interactive verifiable computing: Outsourcing computation to entrusted workers", in Proc. of CRYPTO'10, Aug 2010.
- [5] M. Atallah and K. Frikken, "Securely outsourcing linear algebra computations", in Proc of ASIACCS, 2010, pp. 48-59.
- [6] N. Gohring, "Amazon's S3 down for several hours", Online at http://www.pcworld.com/businesscenter/article/142549/amazons_s3_down_for_several_hours.html, 2008.
- [7] Amazon.com, "Amazon Web Services (AWS)", Online at <http://aws.amazon.com>, 2008.
- [8] Sun Microsystems, Inc., "Building customer trust in cloud computing with transparent security," 2009, online at https://www.sun.com/offers/details/sun_transparency.xml.
- [9] M. J. Atallah, K. N. Pantazopoulos, J. R. Rice, and E. H. Spafford, "Secure outsourcing of scientific computations," Advances in Computers, vol. 54, pp. 216–272, 2001
- [10] M. J. Atallah and J. Li, "Secure outsourcing of sequence comparisons," Int. J. Inf. Sec., vol. 4, no. 4, pp. 277–287, 2005.
- [11] D. Benjamin and M. J. Atallah, "Private and cheating-free outsourcing of algebraic computations," in Proc. of 6th Conf. on Privacy, Security, and Trust (PST), 2008, pp. 240–245.
- [12] A. C.-C. Yao, "Protocols for secure computations (extended abstract)," in Proc. of FOCS'82, 1982, pp. 160–164..
- [13] O. Goldreich, S. Micali, and A. Wigderson, "How to play any mental game or a completeness theorem for protocols with honest majority," in Proc. of STOC'87, 1987, pp. 218–229.
- [14] W. Du and M. J. Atallah, "Secure multi-party computation problems and their applications: a review and open problems," in Proc. of New Security Paradigms Workshop (NSPW), 2001, pp. 13–22.
- [15] P. Golle and I. Mironov, "Uncheatable distributed computations", in Proc. of CT-RSA, 2001, pp. 425-440.
- [16] J. Li and M. J. Atallah, "Secure and private collaborative linear programming," in Proc. of CollaborateCom, Nov. 2006.
- [17] W. Du, J. Jia, M. Mangal and M. Murugesan, "Uncheatable grid computing", in Proc. Of ICDCS, 2004, pp. 4-11.

AUTHORS

First Author – Rajendra N. Kankrale, IT Dept, SRES COE, SPPU, Pune., rkankrale@gmail.com
Second Author – Mahendra B. Gawali, IT Dept, SRES COE, SPPU, Pune., gawali_mahen@yahoo.com

Application of Principles of Process Re Engineering for Improvement of Functional Flows of Dietary Services of a Tertiary Care Hospital

Dr Shashikant Sharma, Dr Sameer Mehrotra

Department of Hospital Administration, Armed Forces Medical College, India

Abstract- The purpose of the study was to identify, study analyse and improve the various functional flows in a Dietary Service of a Tertiary Care Teaching Hospital in India. This observational and descriptive study is based on the concept of improvement through Process Reengineering to map the As-Is and To-Be processes. The study identifies key areas of concern and recommends improvement measures for improvement of quality of services provided by applying principles of process reengineering.

Index Terms- As-Is & To-Be Processes, Dietary Services, Process reengineering, Quality

I. INTRODUCTION

Dietary services is one of the most important hospital support services contributing to the recovery of health through scientifically prepared diets and educating the patients regarding the use and utility of different foods and balanced diets.

Planning principles for efficient and effective dietary services for a hospital are as under [1]:

- Patients receive food according to their clinical needs.
- Nutritional therapy is planned and provided in a collaborative manner.
- Food is prepared, handled, stored and distributed in a safe manner.
- The dietary services to be designed in a manner that there is no criss-cross of traffic. All the activities fall in a sequence.
- Dedicated food storage/refrigeration areas exist to ensure food preservation.
- Food storage areas/refrigerators are maintained appropriately.
- All food products are stored off the floor.
- Cleaning supplies stored in a separate location way from food.
- Separate dedicated food preparation areas exist.
- Measures are in place to ensure that flies do not come in contact with pre pared/stored food.
- Food distribution to patients occurs where possible in temperature appropriate food service trolleys (hot food kept hot and cold food kept cold).
- Application of principles of ergonomics as far as possible

Ideal Layout and functional flows [2]

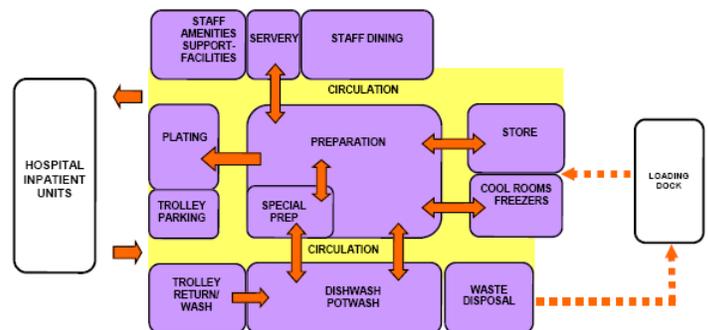
The dietary services have four major zones based on the function.

Zone 1 where reception, inspection, storage and issue f of raw materials is conducted.

Zone 2 where preliminary preparation of food, peeling, cutting f vegetables and washing procedures are carried out.

Zone 3 for cooking area.

Zone 4 as waste disposal area.



Reengineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance such as cost, quality, service and speed. [3]. Now the question comes what to reengineer? According to many in the Business Process Reengineering field of reengineering should focus on processes and should not be limited to thinking about organizations. After all, the organization is only as effective as its processes.

Talking about the importance of processes just as institutions has organization charts they should also have what is called as process maps to give a picture of how work flows in a particular service. Process mapping provides tools and proven methodology for identifying your current As-Is functional processes and can be used to provide a To-Be roadmap for reengineering of product or service. [3]

After a feedback from the stakeholders it was identified that the dietary services of the tertiary care teaching hospital has issues of suboptimal service delivery. The clientele and staff highlighted the issues of inadequate and poorly maintained equipment, insufficient staff, poor service, inadequate space, more time for service delivery and poor waste management practices.

II. AIM & OBJECTIVES

Aim: To enhance the standard of Quality of Dietary Services in a Tertiary Care Hospital by applying principles of process re-engineering.

Objectives:

1. To understand the functional process flows and existing infrastructure of dietary services and process maps.
2. Apply principles of process engineering to the existing processes.
3. Recommend improved functional flows along with infrastructural changes so that form follows function and overall quality improvement of dietary services.

III. METHODOLOGY

An observational and descriptive study was carried out in Dietary Services of a tertiary care teaching hospital. The study was carried out for a period of three months from January to March 2015. A consolidated methodology with a structured approach has been adopted to facilitate understanding of the processes which includes:

Building cross functional teams

Adequate representation from stakeholders

Map and analyse As –Is Process:

- a) Study of relevant guidelines on the subject:
- b) Physical study of the existing facility. and functional processes
- c) On ground measurement of space available and flanking verandahs
- d) Study of available documents

Design To- Be Processes:

- a) Benchmarking Processes
- b) Design To Be processes

IV. OBSERVATIONS AND SUGGESTIONS

The observations are made with respect to improvement in location of physical facilities as per best practices, Functional process flows, infrastructure improvements and suggested equipment and costing with an aim for efficient and effective dietary services.

Physical facilities (Figure 1)

- a) **Location.** The kitchen is located on the ground floor of the hospital.
- b) **Interdepartmental relationship.** The hospital kitchen is appropriately located with easy access from all the departments with lifts available for transportation of food.
- c) **Accessibility** The kitchen is assessable from two places with dedicated entrance for receipt of raw materials and other end for delivery of food.

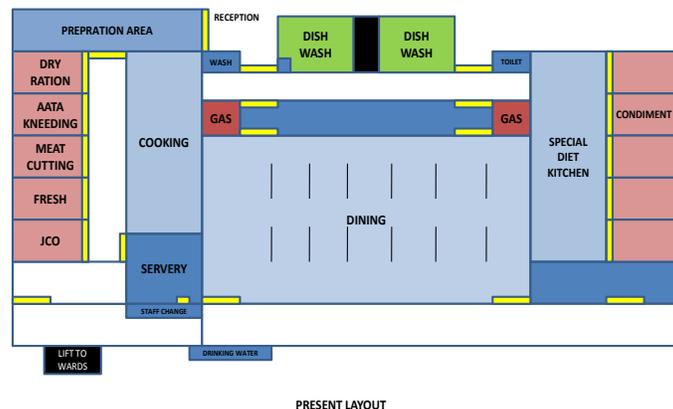


Figure 1: Present Layout

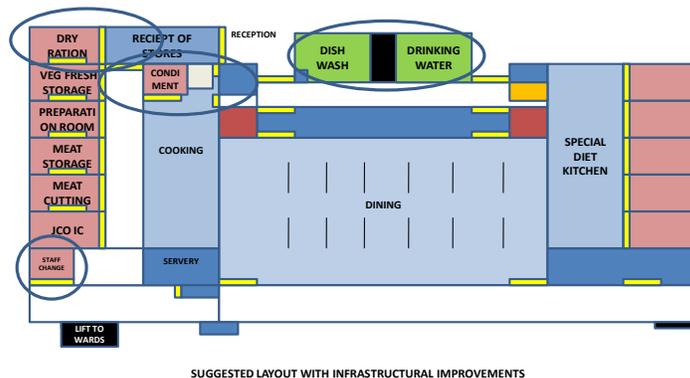


Figure 2: Suggested layout with infrastructural improvements

Functional Processes

A critical examination of the work processes was undertaken identifying the various activities in the process. Broadly the processes undertaken were reception of stores, layout of the facility, flow of storage and preparation area, movement of pots, dining member flow and retrieval of condiments.

The activities under the respective processes included:

- (a) **Preparation of Food.** The activities undertaken in the process were fetching of dry, fresh and perishable ration from store room, inspection of ration, chopping & washing of vegetables, kneading of dough, cooking of food, shifting of cutting table, preparation of chapattis and transport and storage of food in pantry.
- (b) **Dining Room Service.** Dining Room service identified the following activities; transport of food to warmer in dining room, service, dirty

- (c) plates collected and transferred to wash area in pantry and transport of left over food to pantry.
Cleaning & Upkeep. Cleaning and upkeep of the activities included washing of plates and utensils in wash area, transport of clean plates to stacked area and storage, transport of clean kitchen utensils and storage, transport of waste disposal to waste bin through kitchen, retrieving of cleaning material and cleaning of kitchen and dining room, storage of cleaning material and inspection of kitchen.

Activity No 1

Activity Element	Observation	Improvement measures
------------------	-------------	----------------------

Reception of stores <u>Place</u> – Open area in front of the entrance <u>Means</u> - Manual retrieval (Figure 1)	No platform for reception of stores Absence of trolley bay No covered area for reception of stores After retrieval from vehicle temporary storage clubbed with preparation area which is hindering the ideal functional flow. Multiple Ventilating windows present	Platform can be built utilizing a part of parking space Provisioning of trolley bay along the platform built in parking space. Over head shelter for receipt of stores from vehicle The reception cum preparation area can be divided into two parts with. The one near entrance for receipt and temp storage of stores and next one for storage of Dry ration. Needs to be closed (Figure 2)
--	--	---

Activity No 2

Activity Element	Observation	Improvement measures
Layout and flow of storage and preparation area (Figure 1)	Layout of various subsections like aata kneeding room, meat cutting room, fresh ration storage etc leading to repeated crisscrossing.	Modification as suggested in layout to enable ideal functional flow and facilitating easy retrieval.

(Figure 2)

Activity No 3

Activity Element	Observation	Improvement measures
Movement of pots from cooking to pot Washing area and back Place- Cooking hall Sequence – used pots and cleaned pots entering and leaving from same door Means - Manual work (Figure 3)	Mixing of clean and dirty traffic Inefficiency in flows Inappropriate layout	Separate flow for clean and dirty traffic to improve processes as suggested in the layout (Figure 4)

Activity no 4

Activity Element	Observation	Improvement measures
Disposal left over food/ Waste from preparation, cooking and pot washing area Place - Through cooking area Sequence - Dirty flow through cooking area in each activity Means – Manual (Figure 3)	No dedicated path disposal of waste Mixing of clean and dirty traffic	Developing segregated path for waste as per the modifications suggested (Figure 4)

Activity No 5

Activity Element	Observation	Improvement measures
Dining member flow Place - Dining room Sequence – Entry and exit from same door with location of drinking water at the entrance of the room. (Figure No 5)	Mixing of incoming and outgoing traffic Absence of hand washing area Inappropriate location of drinking water area Exit doors for outgoing traffic present but closed	Relocation of drinking water area and instead having hand washing area in the same location. The closed doors can be open to segregate the incoming and outgoing traffic (Figure No 6)

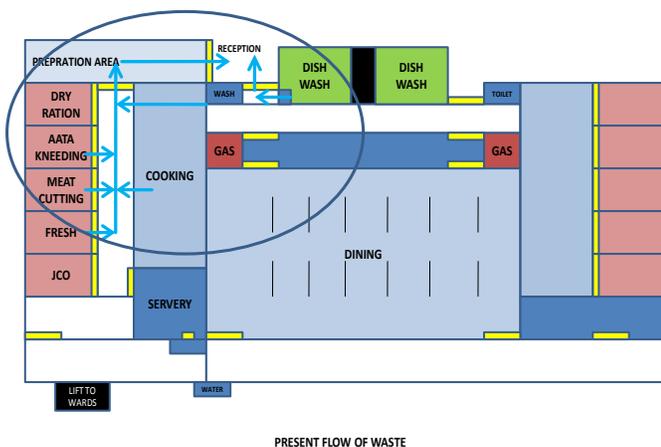


Figure 3: Activity no 3 & 4 (Existing)

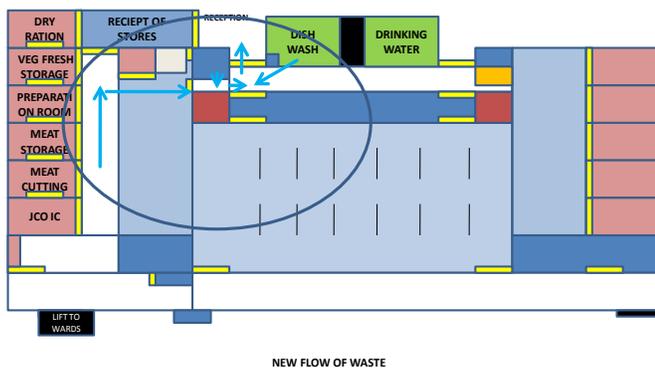


Figure 4: Activity no 3 & 4 (Improved)

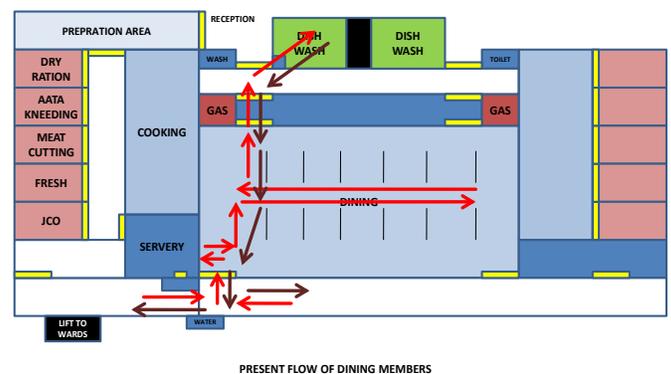


Figure 5: Activity no 5 (Existing)

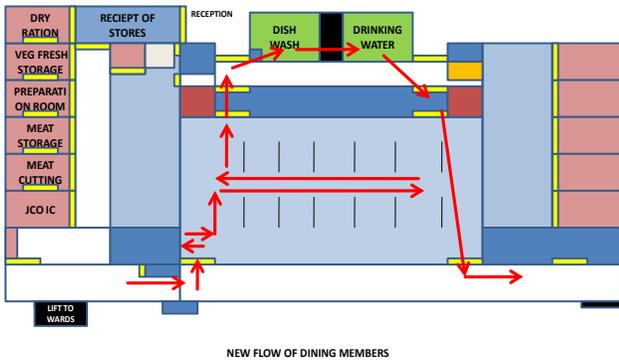


Figure No 6: Activity No 5 (Improved)

Due to above mentioned improvements some of the other processes improved automatically for e.g. flow of serving of food to dining hall and wards. (Figure 7 & 8), reception and movement of raw materials inside the kitchen (Figure 9 & 10) and entry and movement of cooking staff (Figure 11 & 12).

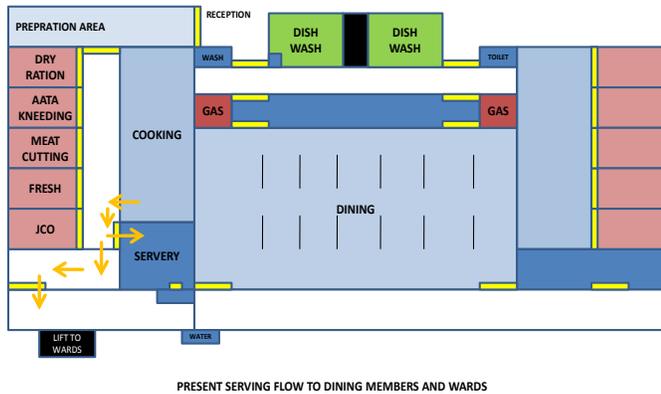


Figure 7: Serving of food (Existing)

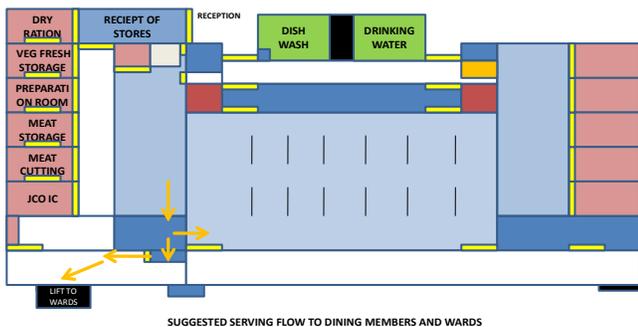


Figure 8: Serving of food (Improved)

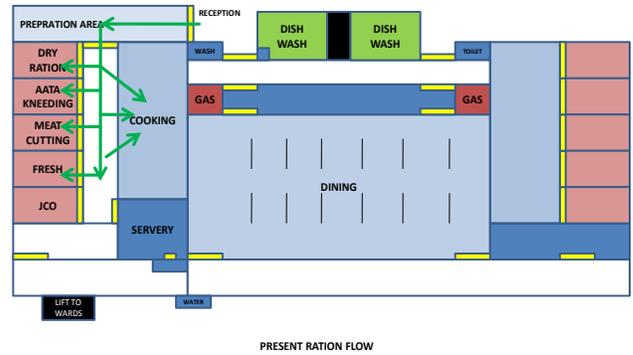


Figure 9: Movement of raw materials (Existing)

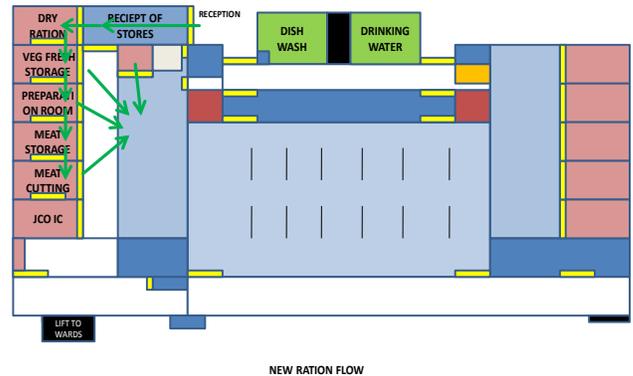


Figure 10: Movement of raw materials (Improved)

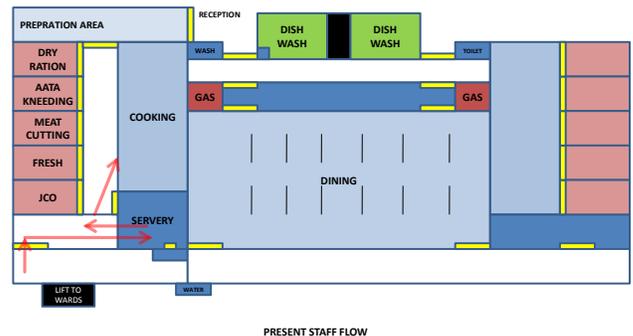


Figure 11: Movement of staff (Existing)

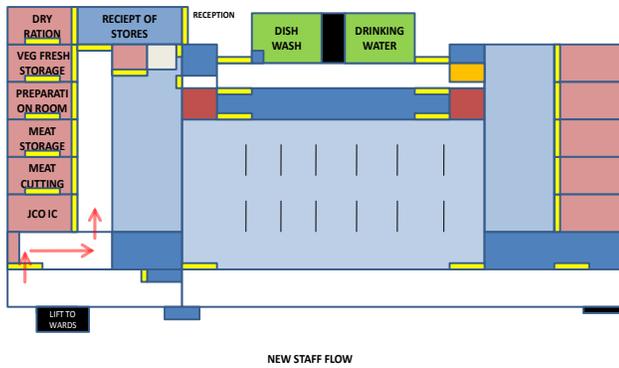


Figure 12: Movement of staff (Improved)

Overall process improvement: An overall process improvement was seen at the end of the study. Figure No 13 & 14 aptly depicts no criss crossing of traffic.

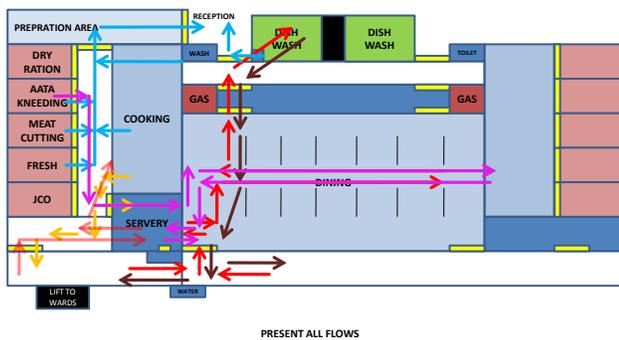


Figure No 13: Existing flows

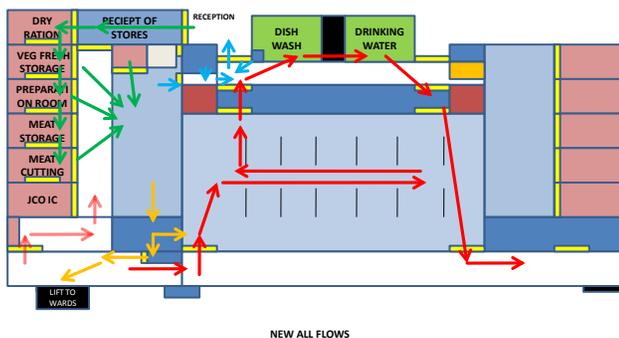


Figure No 14: Improved flows

V. DISCUSSION

This study was conducted for a period of three months in Dietary Services of a Tertiary Care Teaching Hospital. The study was designed to identify and analyze the deficiencies in the existing processes. The concepts and principles of process reengineering have been applied to improve the process outcome of the services. Infrastructure improvements were also suggested so that form follows function.

VI. CONCLUSION

Quality and efficiency of dietary services, like any other departments, can be improved through modern scientific management techniques can be applied in health care facility settings to improve work processes. The problem issues listed above are an apt organizational environment to implement these practices and bring efficiency and economy. Principles of Process Reengineering can be applied to Dietary Services thus radically redesigning the process and carry out various infrastructural improvement necessary to bring about a change in efficiency and effectiveness of dietary services of the hospital.

REFERENCES

- [1] Guidelines for accreditation of Hospitals and Health Care Providers., National Accreditation Board for Hospitals and Health Care Providers 2011, pp. 61–62.
- [2] Shakti Kumar Gupta. et al., Modern Trends in Planning and Designing of Hospitals: Principles and Practice, 2009, pp. 141–145.
- [3] Proceedings of the 4th Annual International Conference on Industrial Engineering Theory, Applications and Practice November 17-20, 1999, San Antonio, Texas, USA.

AUTHORS

First Author – Dr Shashikant Sharma ,MBBS, MD (Hospital Administration, Persuing), Armed Forces Medical College, India and E mail: shashi0681@gmail.com

Second Author – Dr Sameer Mehrotra ,MBBS, MD , DNB (Hospital Administration), Armed Forces Medical College, India and E mail: sammydoc@gmail.com

Correspondence Author – Dr Shashikant Sharma Email id: shashi0681@gmail.com, Alternate email address: meshashi06@gmail.com ,8412821773, (011)27025180.

Enhancement in AODV Protocol to Provide Best Path According to Signal Strength

Deepti Bansal¹, Megha vij²

M.Tech, CSE, IITT, Punjab, India

Abstract- AODV is used to find out the path of the data transfer. But simple AODV has the problem when the nodes move. Enhancement in AODV is required so that to overcome the problem of link failure during data transfer from host to destination. First of all mutual authentication is required between the mobile nodes to prevent the various inside and outside attacks. When the mobile nodes are mutually authenticated, it leads to the reliable data transmission between the mobile nodes. But the main problem occurs during the failure of the link. Due to link failure packet is lost easily. In proposed work, enhancement in AODV concept is important. This protocol is designed to provide best path according to signal strength. The path which has maximum signal strength will choose as a final path. This work will helps to reduce the problem occur in link failure and packet lost problem. Now the performance degradation problem will also improve. In new AODV, route selection is based upon the signal strength. The maximum signal strength nodes are considered as final routes.

Index Terms- AODV, MANET, ROUTING PROTOCOLS, SIGNAL STRENGTH

I. INTRODUCTION

The glory of communication system seems new but surrounded by different evolution eras, transformations. Enormous approached were adopted and become obsolete from time to time as new technological revolutions make communication systems up to date.

Reliable and un failing transportation of data and information from source to destination is important factor in communication process .The mobile phone technology becomes integral part in the world as it is accessed everywhere. Mobile ad-hoc technology has attracted the attention of communication field . An ad-hoc network can operate in an isolated fashion. In Mobile ad-hoc Networks (MANET) mobile nodes communicate with each other without the need of central architecture. MANET are specific type of networks without infrastructure. In ad-hoc Networks there are no base station and there are no supervisors monitoring performance as a whole. Mobile ad-hoc Networks are divided into two categories: structured and unstructured network .An unstructured mobile ad-hoc network consists of nodes that exchanges information without using a fixed base station. In this network nodes not only performs administrative duties but also acts as host. The mobile nodes that are in radio range of each other communicate directly, whereas other needs the aid of intermediate nodes to route their packets. Networks are composed of wireless devices and besides this form a network

with self organization .In Manet topology is randomly changing and unpredictable because of the mobility of network nodes. In addition new nodes can be added to network at any moment, removed from network at any moment, or may turn themselves off.

Some of the important characteristics of ad-hoc network:

- 1 Nodes are autonomous in behavior.
- 2 Nodes can leave or join the network at anytime make it dynamic in nature.
- 3 Minimum human intervention to configure the network.
- 4 Lower getting-started costs due to centralized administration.
- 5 Nodes in ad-hoc network do not rely on any hardware or software.
- 6 Self healing through continuous re-configuration.
- 7 Self-configuring nodes are also routers.

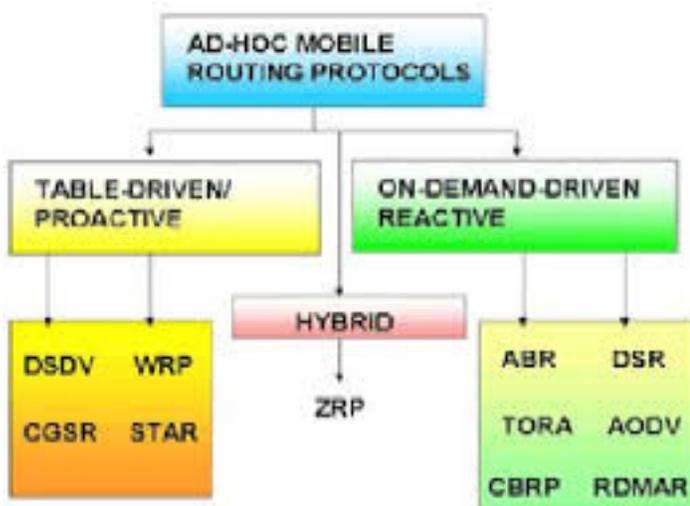
The importance of ad-hoc network is highlighted in many fields. The ad-hoc networking technology is gaining effort with increasing number of widespread applications. The ad-hoc network architecture can be used in real-time business applications, corporate companies to increase the productivity and profit

II. ROUTING PROTOCOLS FOR AD-HOC NETWORK.

A routing protocol is needed to discover the route from sender to receiver. The routing protocol should have these characteristics.

- 1 Minimal overhead of control functions.
- 2 Routing functionality over multiple hops.
- 3 Managing dynamic topology
- 4 Preventing loops in discovered routes.

Three basics approaches are taken for routing protocols in mobile ad-hoc network.



1 PROACTIVE routing protocols:

- Each node maintains route to other node.
- Periodically and/or event- based exchange of routing information.
- Unnecessary bandwidth wastage in sending control packets.
- Not suitable for large networks, as it needs to maintain route information every node’s routing table.,
- Examples: DSDV(Destination Sequence Distance Vector Routing),OLSR(Optimized Link State Routing).

2 REACTIVE routing protocols(On demand)

- Sources initiate route discovery on demand.
- It does not need to search for and maintain the routes on which there is not route request.
- Very pleasing in resource limited environment.
- Only active routes are managed
- Less control overhead and better scalability than proactive routing protocols.
- Examples: AODV, DSR

3 HYBRID routing protocols

- Combination of both protocols.
- Example: ZRP

The reactive routing protocol (AODV) are now in the process of being standardized and implemented .AODV is designed for ad- hoc networks that vary in wide range of sizes from very small one enabled nodes to thousands of enabled nodes.

III. AODV PROTOCOL

AODV protocol allows mobile nodes to quickly obtain routes for new destinations and it does not require nodes to maintain routes to destination that are not in active mode. AODV routing permits the mobile node to respond to link breakages and changing in network topology in timely manner. The routes are maintained as long as required by the sources. They also form trees to connect multicast group members. AODV make use of sequence number to ensure freshness of routes. AODV is considered as on demand algorithm that does not create any extra

traffic for communication along links. In AODV networks are silent until connections are established. In AODV control messages used are:

- Route Request Message(RREQ)
- Route Reply Message(RREP)
- Route Error Message(RERR)
- Route Reply Acknowledgement Message(RREP-ACK)

These messages are used to discover and maintain routes across the network from source to destination by use of UDP packets. Whenever there is need to create a new route to the destination, the node which is requesting broadcasts Route Requests. A Route is determined when this message reaches the next hop node (intermediate node with routing information to the destination) or the destination itself and the RREP has reached the originator of the request. Routes from the originator of the RREQ to all the nodes that receive this message are cached in these nodes. When a link failure occurs, Route Errors (RERRs) message is generated.

Source node broadcasts the packets to its neighbor nodes with RREQ and updates its table. Then these nodes further forwards packets to its neighbor until the destination find out and fresh route find out. Each node maintains its sequence number and broadcast ID. For every RREQ the node initiates broadcast ID which is incremented and together with the node's IP address uniquely identifies an RREQ. At last that route will be the final route that has the minimum hop count from source to destination.

IV. PROPOSED METHODOLOGY

But in our proposed work, enhancement of AODV network is deployed same as in AODV networks. Nodes are free to move anywhere. There is no central controller in the system. Data transfer from source to destination.

Similarly with the help of RREQ message data is broadcast. RREQ message is sent from destination to source as a response. But main difference in Enhancement AODV is RREQ message than simple AODV. Header part is added in RREQ message which helps to find out the destination. To find out the best path first assumption is based upon the signal strength. Destination nodes check the vicinity of the adjacent nodes and those nodes further checks the vicinity of their adjacent nodes. After that source find out the average of the path. The path which has the maximum average value is selected as the final path. This value lies between 1 to 10. So this will overcome the problem of link failure. We will follow that path only which has the highest signal strength. Second assumption is based upon the hop count similar as AODV protocol. The path which has the minimum hop count is considered as the final path. Third assumption is based upon the sequence number.

V. SIMULATIONS

Network Simulator (version 2), is known as NS2, it is an event driven simulation tool that has proved useful in studying the dynamic nature of communication networks. Simulation of

wired and wireless network functions and protocols like TCP, UDP and routing algorithms, can be done using ns2. The simulation is the technique which shows us the behavior of modal when actually embedded into the network. Figure 4.1 shows the basic architecture of ns2. NS2 provides users with an executable command ns which takes on input argument, the name of a Tcl simulation scripting file. Users are feeding the name of a Tcl simulation script as an input argument of an ns2 executable command ns. In most of the cases, a simulation trace file is created, and is used to plot graph and or to create animation.

VI. RESULTS

Throughput:

The efficiency of the AODV increase with the help of signal strength. The throughput the network is enhanced through the use of new proposed technique because the packet loss in the network is reduced. The results help to improve the performance of the system.

Packet Loss:

During link failure problem packet loss occur in old AODV. But this problem can be overcome signal strength in enhanced AODV.

Delay Graph:

Delay graph represents that old AODV has more delay than new AODV. Thus transmission is fast in new AODV which helps to improve performance.

REFERENCES

- [1] S. Zeadally E. Yaprakl Y. Li X. Che , “A Survey of Network Performance Tools For Computer Networks Classes” , Division of Engineering Technology, 2001
- [2] Asha Ambaikar, H.R. Sharma, V. K. Mohabey , “ Improved AODV for Solving Link Failure In Manet” , International Journal of Scientific & Engineering Research, Volume 3, Issue 10, October-2012 1 ISSN 2229-5518 2012
- [3] Sunil Kumar and Pankaj Negi , “A Link Failure Solution in Mobile Adhoc Network through Backward AODV (B-AODV)”, IJCEM International Journal of Computational Engineering & Management, Vol. 11, January 2011 ISSN (Online): 2230-7893, 2011
- [4] Ravindra .E, VinayaDatt V Kohir and V. D Mytri , “A Local Route Repair Algorithm Based On Link Failure Prediction In Mobile Adhoc Network”, World Journal of Science and Technology 2011, 1(8): 64-67 ISSN: 2231 – 2587, 2011
- [5] Srinath Perur, Abhilash P. and Sridhar Iyer , “Router Handoff: A Preemptive Route Repair Strategy for AODV” IEEE, 2003
- [6] Donatas Sumyla, “ Mobile Adhoc Networks” , IEEE Personal Communications Magazine, April 2003, pp. 46-55.

AUTHORS

First Author – Deepti Bansal, M.Tech, CSE, IITT, Punjab, India, deeptibansal1988@gmail.com

Second Author – Megha vij, M.Tech, CSE, IITT, Punjab, India megha.vij0001@gmail.com

Physico-chemical characterization and kinetic study of methylene blue adsorption onto a Moroccan Bentonite

Ikram DAOU, Omar ZEGAOUI, Rachid CHFAIRA, Hammou AHLAFI and Hamou MOUSSOUT

Research Team: Materials and Applied Catalysis, Laboratory "Chimie-Biologie Appliquées à l'Environnement", Department of Chemistry, Faculty of Sciences, Moulay Ismail University, PB. 11201 Zitoun, Meknès, Morocco

Abstract- A Moroccan Bentonite taken from a geological site in the North-Eastern Rif of Morocco has been characterized by XRF, CEC measurements, XRD, IRTF, SEM and N₂ adsorption/desorption at -196 °C. The results showed that the structure of the purified bentonite (PB) is constituted exclusively of monmorillonite and some Mg²⁺ and Fe³⁺ cations replace Al³⁺ in the octahedral sheet. The specific surface area developed is of 74 m² g⁻¹, and the diameters of pores are superior to 38 Å indicating the presence of mesopores. The adsorption study of methylene blue (MB) onto PB showed that the percentage removal of this molecule can reach 99.6%, and the amount of MB adsorbed depends closely on adsorbent dosage, pH and solution temperature. The results of the adsorption tests showed that the experimental data fitted very well the pseudo second order model. Also, it was found that for temperatures ≤ 45 °C, the adsorption process proceeds by surface adsorption followed by an internal diffusion into the particles with Ea=49.7 kJ.mol⁻¹; while for temperatures ≥ 55 °C, it is governed by an internal diffusion into the particles with Ea = 2.3 kJ.mol⁻¹. The low Ea values are characteristic of physical adsorption.

Index Terms- Moroccan Bentonite, Montmorillonite, Adsorption kinetics, Methylene Blue, Pseudo second order model, Intra-particle diffusion

I. INTRODUCTION

This article guides a stepwise walkthrough by Experts for writing a successful journal or a research paper starting from inception of ideas till their publications. Research papers are highly recognized in scholar fraternity and form a core part of PhD curriculum. Research scholars publish their research work in leading journals to complete their grades. In addition, the published research work also provides a big weight-age to get admissions in reputed varsity. Now, here we enlist the proven steps to publish the research paper in a journal.

The textile industries produce a large amount of wastewater fraught with dyes that pollute the aquatic environment. To reduce the negative impact of these pollutants on the environment, this wastewater must be treated before being discharged into rivers. The commonly used methods for dyes removal are biological oxidation, photochemical degradation, chemical oxidation and adsorption on materials [1-8]. The latter has been found to be one of the most efficient physicochemical processes [9]. Adsorption techniques have been conducted successfully in removing color dyes species using various adsorbents such as coal fly ash [10], solid agricultural wastes [11], and clays [12,13]. However, in

recent years clays have attracted great interest because of their important physicochemical properties giving it high sorption ability even for the heavy organic molecules [14]. One of the important properties of clays (e.g. montmorillonite) is that the layers are negatively charged and this negative charge is balanced by hydrated cations placed in the interlayer species leading to high attraction towards cationic dyes, like Methylene Blue. This dye molecule has been largely used as probes to characterize clays [12,15]. The objectives of this work are, on the one hand, the investigation of the physico-chemical of a natural bentonite taken from a geological site in the North-Eastern Rif of Morocco (Region of Nador). On the other hand, the kinetics studies of methylene blue adsorption onto this bentonite.

Experimental

II.1. Bentonite samples

The Bentonite samples used in this work belong to the same batch of raw natural bentonite taken from a geological site in the North-Eastern Rif of Morocco. Its purification consists in ridding it of all crystalline phases (quartz, feldspar, Calcite, etc) and retaining only well-defined size fractions, those of less than 2 microns. Typically, 100 mg of raw bentonite were dispersed in 500 mL of distilled water and kept under constant agitation for 1 hour. The suspension was transferred to a burette with a capacity of 500 ml and left to precipitate for 10 min. The collected fraction is the one corresponding to 2 cm from the height of the upper limit. It was then centrifuged for 10 min 5000 revolutions per minute (rpm) and dried overnight in an oven at 100 °C. The chemical analysis of the raw and purified samples of Bentonite was carried out using an Axios Sequential X-ray Fluorescence Spectrometer (XRF). The cation exchange capacity (CEC) was determined using a method based on cobaltihexamine chloride absorbance [16,17]. The X-ray diffraction (XRD) patterns of adsorbents were determined with an X'PERT MPD_PRO diffractometer using Cu K α radiation at 45 kV and 40 mA over the range (2 θ) of 4-70°. The determination of the crystalline phases was carried out by applying the Bragg law where $\lambda = 1.5406 \text{ \AA}$. FTIR spectra (400-4000 cm⁻¹) were recorded on a JASCO 4100 spectrophotometer. The samples were prepared in KBr discs from highly dried mixtures of 4% (weight/weight) and stored in desiccators. The size and morphology of the solids obtained were observed by scanning electron microscopy (SEM) (Quanta 200 from FEI Company). N₂ adsorption/desorption measurements at -196 °C were performed using an ASAP 2010. The specific surface area and the average pore diameter were determined according to the standard Brunauer-Emmett-Teller (BET) and Barrett, Joyner and Halenda (BJH) methods, respectively. The pH_{pzc} was determined at 25 °C following a

method based on conductometric titration and described in our previous work [18].

II.2. Chemicals and reagents

Methylene Blue (MB), used in this work as adsorbate, was obtained from Fisher Scientific International Company. $[Co(NH_3)_6]Cl_3$ was purchased from Sigma Aldrich Company and specified to be $\geq 99.5\%$ purity. Bi-distilled water was used in all experiments.

II.3. Adsorption studies

The adsorption kinetic studies were conducted in a batch reactor at different temperatures (25, 35, 45, 55 and 65 °C) in a thermoregulated system to vary the temperature in the reactor between 25 and 100 °C. All the experiments were carried out at a constant speed of 500 rpm. Working solutions of MB were prepared from the stock solution (10^{-3} mol/L) to the desired concentrations for each experimental run. For all the experiments, 50 mg of purified bentonite (PB) sample was added into a 50 mL of unbuffered MB solution (pH \approx 5.6) at desired concentration and temperature. At the end of the adsorption period, the solution was filtered under vacuum by using a

filtration system equipped with micro-porous filter (0.45 μ m). The dye concentration was estimated spectrophotometrically by using a UV/Vis spectrophotometer (Shimadzu 2100 spectrophotometer) at $\lambda_{max} = 662$ nm, corresponding to the maximum absorbance of MB. The amount of MB adsorbed on the PB sample in each time (q_t) was calculated according to the following mass balance equation:

$$q_t = (C_0 - C_t) \frac{V}{m} \quad (1)$$

where C_0 was the initial dye concentration (mg/L), C_t its concentration (mg/L) at time t (min), V the solution volume (L) and m the amount of PB sample used (g).

Results and discussion

III.1. Physico-chemical characterization

Chemical analysis of raw and purified bentonite are shown in Table I. It appears that the purification of the bentonite reduces the amount of silica, alumina, and Na^+ , K^+ and Ca^{2+} cations; however, the amount of Fe_2O_3 and MgO increases. This indicates that a part of the quantity of Fe and Mg is contained in the clay network by substituting Al^{3+} by Fe^{3+} and/or by Mg^{2+} . The CEC obtained for the purified bentonite is of 88.82 meq/g.

Table I: Chemical analysis (%) and CEC (meq/g_{PB}) of raw and purified bentonite.

Sample	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MgO	Na ₂ O	K ₂ O	CaO	OO ^a	LI ^b	CEC (meq/g)
Raw Bentonite	56.15	24.23	1.85	2.04	3.08	0.75	1.21	1.39	9.30	-
Purified Bentonite	54.80	18.00	6.00	5.15	1.75	0.25	0.35	3.50	10.20	88.82

a: Other oxides in trace

b: Loss on ignition at 900°C

In order to check the structure of raw and purified bentonite, XRD analysis was carried out. [Figure 1](#) shows the XRD patterns of (a) raw and (b) purified bentonite. It shows that raw bentonite displays peaks belonging to the montmorillonite structure (denoted M) [\[19,20\]](#) quartz (denoted Q) [\[20\]](#) and cristobalite (denoted C) [\[20\]](#) as well as other unidentified peaks (denoted U) which belong to impurities in trace amounts. Indeed, the spectrum b corresponding to the purified sample shows peaks belonging exclusively to the montmorillonite structure.

The infrared spectra recorded for raw (a) and purified bentonite (b) are evident in the wavenumber range 400-4000 cm^{-1} and are presented in [Figure 2](#). The broad absorption band around 3430 cm^{-1} and the band at 1640 cm^{-1} appearing in the two spectra are due to the stretching and bending vibrations respectively of H₂O adsorbed on the surface and between the interlayer [\[21-24\]](#). The band at 3630 cm^{-1} can be ascribed to the stretching vibration of hydroxyl group in different environments (Al,AlOH), (Al,MgOH) or (Al,FeOH) [\[21-26\]](#). This suggests that Al^{3+} cations are partially substituted by Mg^{2+} and /or Fe^{3+} cations. This is supported by the presence of the band at 915 cm^{-1} and the shoulder 880 cm^{-1} associated with the bending vibration of the OH group in (Al,Al)-OH and (Al,Fe)-OH respectively [\[21-27\]](#). The shoulder near 3240 cm^{-1} observed on the two spectra can be ascribed to an overtone of the bending mode of cation hydration water [\[21,22,24\]](#). Also, we note the presence of

an intense broadband centered at 1038 cm^{-1} that can be assigned to the Si-O vibration of the tetrahedral sheet [\[21,22,28\]](#).

The shoulder near 1115 cm^{-1} is attributed to the vibration of Si-O in an amorphous network of SiO₂ [\[26\]](#). The absorption band at 624 cm^{-1} is related to the perpendicular vibration of the octahedral cations (R-O-Si) where R = Al, Mg or Fe [\[20\]](#). The band at 530 cm^{-1} is attributed to the bending vibration of Si-O in Si-O-Al [\[22,24,28\]](#). The band 459 cm^{-1} is assigned to Si-OF_e and/or Si-OAl vibrations [\[28\]](#).

SEM images show that the raw ([Figure 3A](#)) and purified ([Figure 3B](#)) bentonite samples are composed of homogeneous particles in the form of sheets characteristic of clays. No change in the morphology of the samples can be observed after purification.

[Figure 4A](#) shows that the N₂ adsorption/desorption isotherm at -196 °C recorded for PB sample belongs to the type IV isotherms according to the IUPAC nomenclature [\[29\]](#). This type of isotherm is characteristic for materials that contain aggregated planar particles forming slit shape pores. Such result is in accordance with the literature data [\[25,29\]](#). The adsorption at small values of P/P_0 is an indication of the existence of micropores. At higher relative pressure ($P/P_0 \geq 0.4$), clear hysteresis loop of the H2 type appears. The calculated specific area using the BET method [\[29\]](#) is of 74 $m^2 g^{-1}$. The pores diameter distribution was obtained using the BJH method from the desorption isotherm ([Figure 4B](#)). It shows that the diameters

of pores are superior to 38 Å indicating the presence of mesopores. The total pore volume is 0.09168 cm³ g⁻¹.

The determined pH_{pzc} using the method based on conductometric titration [18] is of 9.2±0.2.

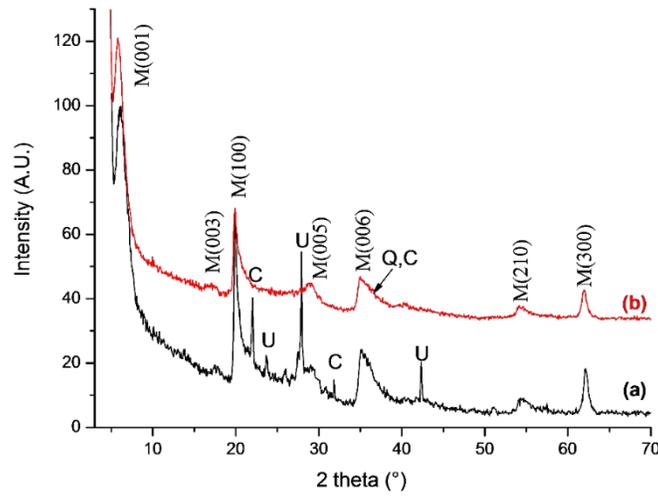


Figure 1: XRD patterns of (a) raw and (b) purified bentonite. M: Montmorillonite. Q: Quartz. C: Cristobalite. U: unidentified

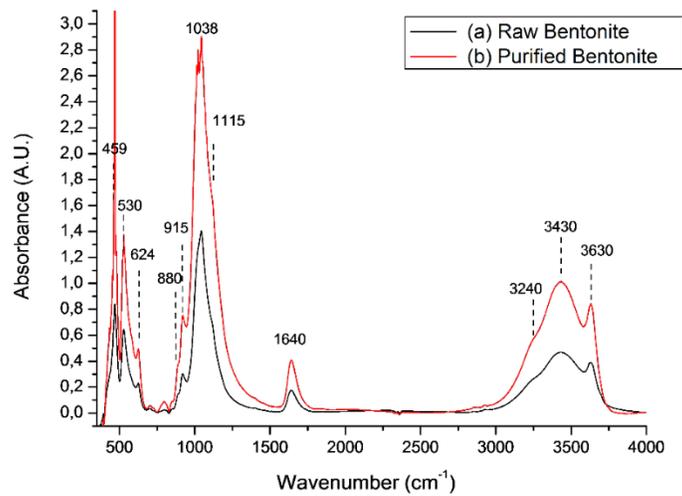


Figure 2: Infrared spectra of (a) raw and (b) purified bentonite.

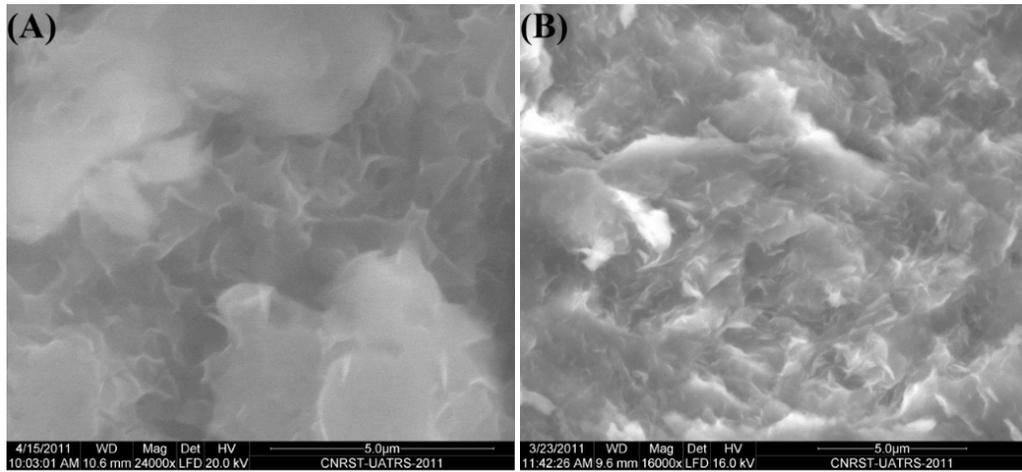


Figure 3: SEM micrographs of (A) raw and (B) purified bentonite.

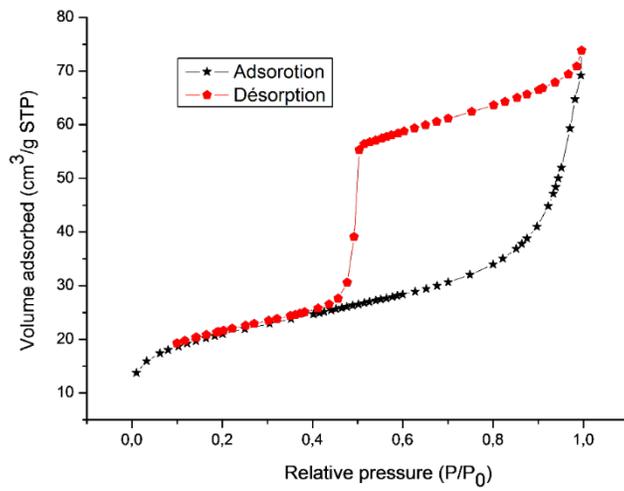


Figure 4A: Nitrogen adsorption/desorption isotherm at -196 °C.

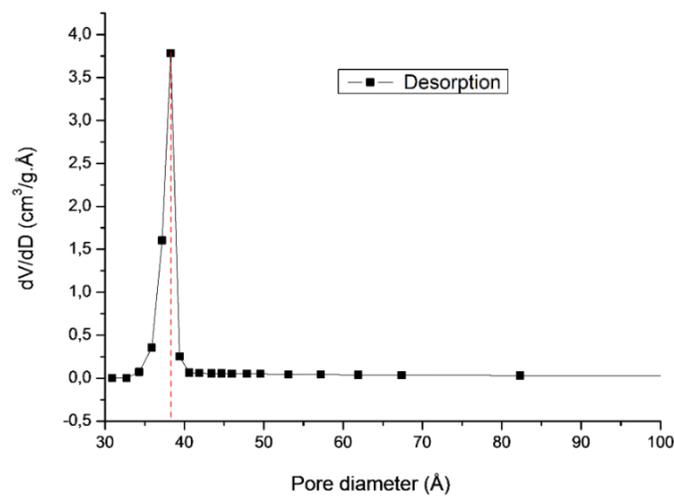


Figure 4B: Pores diameter distribution of purified bentonite particles.

III.2. Kinetic study

III.2.1. Effect of contact time and temperature

The effect of contact time on the adsorption of MB onto PB was studied at five temperatures at different times. Figure 5 shows that the required time in order that no adsorption of MB on PB sample takes place at 25 °C is seven hours. Nevertheless, the adsorption equilibrium is reached more rapidly when the

temperature increases from 25 to 65 °C (adsorption equilibrium is reached in 60 min at 65 °C) indicating an increase in the rate of diffusion of the adsorbate molecules across the external boundary layer and in the internal pores of the adsorbent particles [30]. The removal of methylene blue increases slightly from 297 to 312 mg/g by increasing the temperature of the solution from 25 to 65 °C indicating the process to be endothermic.

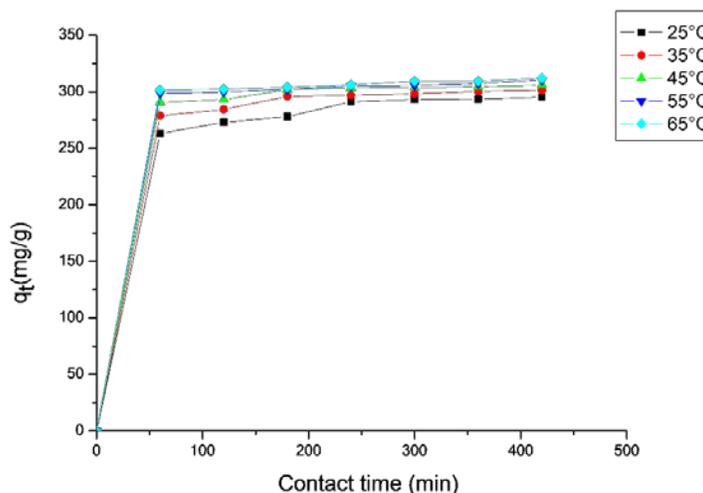


Figure 5: Effect of contact time on the adsorption of MB onto PB at different temperatures.
 $C_{0(MB)} = 10^{-3}$ mol/L ; pH = 5.6 ; $m_{PB} = 50$ mg.

III.2.2. Effect of adsorbent concentration

The effect of PB concentration on MB adsorption at a contact time of 7 hours was studied by varying the bentonite dose from 0.4 to 4 g/L. The volume of the solution was kept constant (50 mL). Figure 6 shows that the amount of methylene blue adsorbed at equilibrium decreases from 377.8 to 79.6 mg/g, while the percentage of removal of MB increases from 47.2 to 99.6% for an increase in adsorbent concentration from 0.4 to 4 g/L. At adsorbent doses between 1.5 and 4 g/L, the percentage of removal of MB changes slightly. This indicates that the more the adsorbent dosage, the larger the volume of effluent that a fixed mass of purified bentonite can purify. The decrease in amount of dye adsorbed q_e (mg/g) with increasing adsorbent mass is due to the split in the flux or the concentration gradient between MB concentration in the solution and in the adsorbent surface. Thus with increasing adsorbent mass, the amount of dye adsorbed onto unit weight of adsorbent gets reduced. Similar results have been obtained by many authors for the adsorption of methylene blue on monmorillonite clay [31] and rice husk [32], and for the adsorption of Congo red on acid activated red mud [33].

III.2.3. Effect of pH

The variation of the amount of MB adsorbed at equilibrium onto PB was investigated as a function of initial suspension pH ($2 \leq \text{pH} \leq 10$). The pH was adjusted using diluted solutions of NaOH or HCl. Figure 7 shows the extent of dye adsorption at different pHs. From this figure, it was observed that the amount of MB adsorbed at equilibrium onto PB increases from 178 to 280 mg/g with the increasing of pH of dye solution from 2 to 8, and then declines slightly to 274 mg/g for pH = 10. Whereas, the percentage of removal of MB increases continuously from 69.7 to 99.5% with increasing pH of MB solution from 2 to 10 indicating that the basic solution was advantageous to MB adsorption onto PB. It is clear that the solution pH influences profoundly the adsorption process as reported by many authors [31,34,35]. The pH_{pzc} determined in this work for purified bentonite is of 9.2. Consequently, for $\text{pH} < 9.2$, the number of negatively charged adsorbent sites decreases and the number of positively charged surface sites increases with decreasing the pH solution in the range 8-2. Then, electrostatic repulsion prevents the adsorption of cationic molecules such as MB^+ [35,36]. Also, lower adsorption of methylene blue at acidic pH can be attributed to the presence of excess H^+ ions competing with dye cations for the adsorption sites [35].

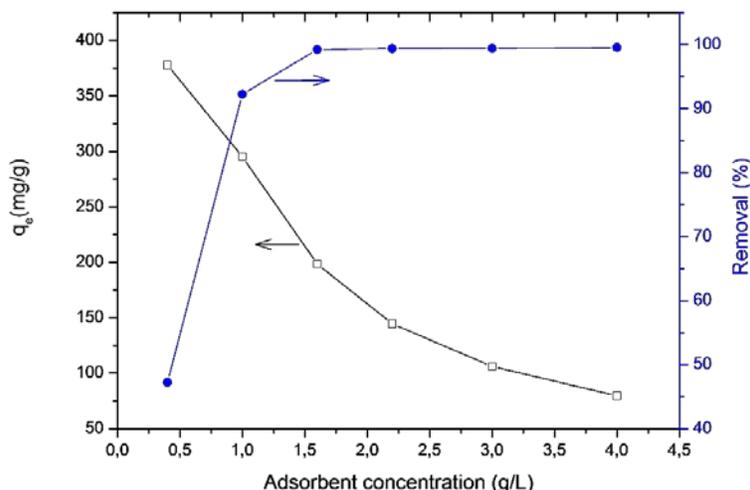


Figure 6: Effect of PB concentration on MB adsorption at equilibrium.
 $C_0(\text{MB}) = 10^{-3} \text{ mol/L}$; $\text{pH} = 5.6$; $V_{\text{sol}} = 50 \text{ mL}$; contact time = 7 h ; $T = 25^\circ\text{C}$.

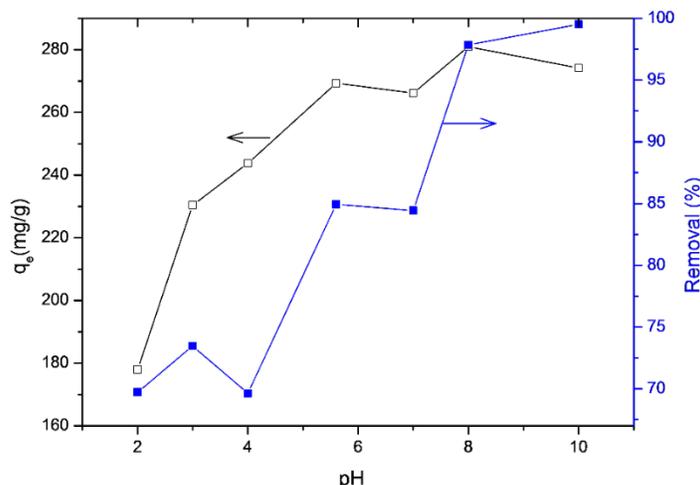


Figure 7: Effect of initial suspension pH on the adsorption of MB onto PB.
 $C_0(\text{MB}) = 10^{-3} \text{ mol/L}$; $m_{\text{PB}} = 50 \text{ mg}$; $V_{\text{sol}} = 50 \text{ mL}$; contact time = 7 h ; $T = 25^\circ\text{C}$.

II.3. Adsorption kinetics

The adsorption kinetic of MB onto PB was studied by applying pseudo first order (Eq. (2) [37]), pseudo second order (Eq. (3) [38]) and intra-particle diffusion (Eq. (4) [39]) models to the experimental data.

$$\ln(q_e - q_t) = \ln q_e - k_1 t \quad (2)$$

$$\frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \frac{t}{q_e} \quad (3)$$

$$q_t = k_i t^{0.5} + C \quad (4)$$

where q_e (mg/g) and q_t (mg/g) are the amount of MB adsorbed onto PB at equilibrium and at time t (min) of adsorption process respectively; k_1 (min^{-1}), k_2 ($\text{g mg}^{-1} \text{min}^{-1}$) and k_i ($\text{mg g}^{-1} \text{min}^{-0.5}$) are the pseudo first order, pseudo second order and intra-particle diffusion rate constants respectively and C is the intercept.

III.3.1. Intra-particle diffusion model

Figure 8 shows the plot between q_t versus $t^{0.5}$ for MB onto PB at different solution temperature and $C_0(\text{MB}) = 10^{-3} \text{ M}$. From this figure, it was found that the sorption process seems to follow one or two steps depending on solution temperature. For temperatures $\leq 45^\circ\text{C}$, the two phases observed in the intra-particle diffusion plots suggest that the adsorption of MB onto PB proceeds certainly by surface adsorption followed by an internal diffusion into the particles. For temperatures $\geq 55^\circ\text{C}$, the plots of q_t versus $t^{0.5}$ show a single straight indicating that the adsorption of MB onto PB proceeds by an internal diffusion into the particles. This behavior can be attributed to the existence of a large amount of mesopores in the sample conjugated to the solubility of MB that increases with increasing solution temperature. On the other hand, intra-particles plots do not pass

through the origin indicating that other processes can control the rate of adsorption simultaneously with intra-particles diffusion [34]. The k_i values calculated from the slopes of the second

linear portion [32] (for $T \leq 45^\circ\text{C}$) and the intercepts are given in Table 2. Generally, the intercept values calculated (Table 2) increase with the increasing of solution temperature.

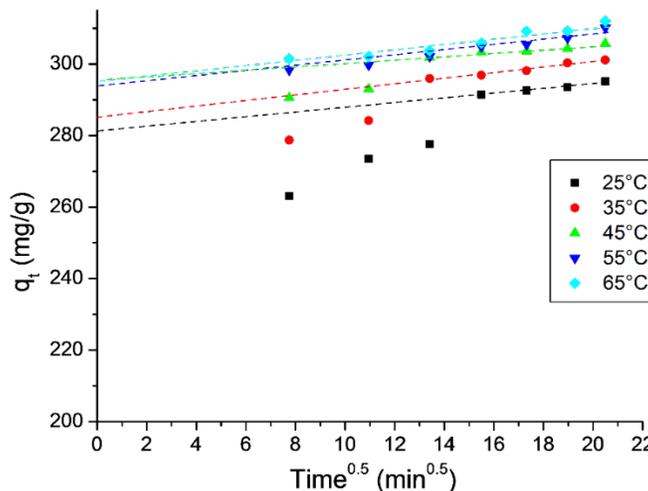


Figure 8: Intra-particle diffusion plot for MB onto PB at different solution temperature.
 $C_0(\text{MB}) = 10^{-3} \text{ mol/L}$; $m_{\text{PB}} = 50 \text{ mg}$; $V_{\text{sol}} = 50 \text{ mL}$; $\text{pH} = 5.6$ (natural).

Table 2: Kinetic values calculated at different temperatures for methylene blue adsorption onto purified bentonite. $C_0(\text{MB}) = 10^{-3} \text{ mol/L}$; $m_{\text{PB}} = 50 \text{ mg}$; $V_{\text{sol}} = 50 \text{ mL}$; $\text{pH} = 5.6$ (natural).

T (°C)	$q_e^{(a)}$ (mg.g^{-1})	Pseudo first order			Pseudo second order			Intra-particle diffusion		
		k_1 (min^{-1})	$q_e^{(b)}$ (mg.g^{-1})	R^2	k_2 ($\text{g.mg}^{-1}.\text{min}^{-1}$)	$q_e^{(b)}$ (mg.g^{-1})	R^2	k_i ($\text{g.mg}^{-1}.\text{min}^{0.5}$)	R^2	$C^{(c)}$
25	297	0.0105	117.0	0.950	0.00048	298.5	0.9996	0.7722	0.959	281.2
35	303	0.0101	87.3	0.919	0.00078	304.0	0.9998	0.7855	0.968	285.4
45	307	0.0103	83.5	0.892	0.00116	306.8	0.9999	0.4952	0.947	294.6
55	311	0.0098	71.5	0.878	0.00120	309.6	0.9999	0.7996	0.949	294.0
65	312	0.0148	114.4	0.866	0.00122	311.5	0.9999	0.9222	0.932	294.0

(a) and (b) : the experimental and calculated q_e values respectively
 (c) : the intercept values

III.3.2. Pseudo first order and pseudo second order models

In order to investigate the mechanism of adsorption, the pseudo first order and pseudo second order kinetics model were used to test the experimental data. The coefficients of determination and the pseudo first order rate parameters as well as the pseudo second order rate parameters are shown in Table 2. On the basis of q_e and R^2 values obtained for the two kinetic models, it is clear that the experimental data fit very well the pseudo second order model. Indeed, the calculated $q_{e,2}$ values are very close to those obtained experimentally and the coefficients of determination for the pseudo second order kinetic model are very close to 1 indicating the applicability of the kinetic Eq. (3) expressing the pseudo second order nature of the adsorption process of methylene blue onto purified bentonite. Similar results have been reported for the adsorption of methylene blue onto perlite [30] and monmorillonite clay [31].

Also, Table 2 shows that k_2 increases with the increasing of solution temperature which is consistent with a physisorption [39].

III.4. Activation parameters

The activation energy was calculated from the linearized Arrhenius equation (Eq. (5)) and the pseudo second order rate constants obtained at different temperatures.

$$\text{Ln}k_2 = \text{Ln}A - \frac{E_a}{RT} \quad (5)$$

where k_2 is the pseudo second order rate constant ($\text{g mg}^{-1} \text{ min}^{-1}$), A a temperature independent Arrhenius factor ($\text{g mg}^{-1} \text{ min}^{-1}$), E_a the activation energy (J mol^{-1}), R the gas constant ($\text{J mol}^{-1} \text{ K}^{-1}$) and T the solution temperature (K).

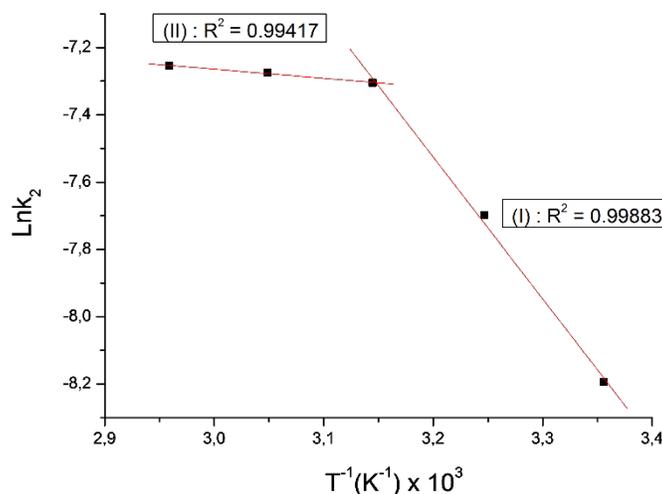


Figure 9: Arrhenius plot for adsorption of MB onto PB.
 $C_0(\text{MB}) = 10^{-3} \text{ mol/L}$; $m_{\text{PB}} = 50 \text{ mg}$; $V_{\text{sol}} = 50 \text{ mL}$; $\text{pH} = 5.6$ (natural).

As shown in [Figure 9](#), the plot of $\text{Ln}k_2$ vs T^{-1} gives two straight lines with a good coefficient of determination. The E_a values calculated from the slopes are 49.7 and 2.3 kJ mol^{-1} for the straight lines (I) and (II) respectively. This behavior suggests that the sorption process of MB onto PB proceeds by two different mechanisms depending on solution temperature. These results confirm those obtained previously. For temperatures $\leq 45^\circ\text{C}$, the adsorption process is certainly governed by surface adsorption followed by an internal diffusion into the particles. The value of E_a (49.7 kJ mol^{-1}) is characteristic of physical adsorption [40]. For temperatures $> 45^\circ\text{C}$, the very low value of obtained E_a (2.3 kJ mol^{-1}) corresponds, also, to physisorption [40] and indicates that the rate is controlled by intra-particle diffusion mechanism [40,41].

II. CONCLUSION

The bentonite sample collected in Nador region was characterized using different techniques as XRF, CEC measurements, X-ray diffraction, infrared spectroscopy, SEM observations and N_2 adsorption/desorption measurements at -196°C . The results show that the crystalline structure of purified bentonite is exclusively constituted of monmorillonite and some Mg^{2+} and Fe^{3+} cations replace Al^{3+} in the octahedral sheet.

The adsorption and kinetic studies show that:

- The MB adsorption equilibrium is reached in approximately seven hours at 25°C and one hour at 65°C . The removal percentage of MB can reach 99.6% and the amount of the adsorbed dye depends closely on adsorbent dosage, pH solution and solution temperature.

- A comparison of the kinetic models showed that the MB sorption onto PB was described very well by the pseudo second order rate model. It was also found that for temperatures $\leq 45^\circ\text{C}$, the adsorption of MB onto PB proceeds certainly by surface adsorption followed by an internal diffusion into the particles with activation energy of 49.7 kJ mol^{-1} . While for temperatures $\geq 55^\circ\text{C}$, the adsorption process proceeds by an internal diffusion

into the particles with activation energy of 2.3 kJ mol^{-1} . This behavior is consistent with the description of the sorption process as involving physisorption and two different mechanisms depending on solution temperature.

REFERENCES

- [1] S.M. Ghoreishi, R. Haghghi, Chem. Eng. J. 95 (2003) 163-169.
- [2] A.K. Jain, V. K Gupta, A. Bhatnagar, Suhas. J. Hazard. Mater. B101 (2003) 31-42.
- [3] Y.S. Ho, G. McKay, Process Biochem. 38 (2003) 1047-1061.
- [4] F. Derbyshire, M. Jagtoyen, R. Andrews, A. Rao, I. Martin-Gullon, E. Grulke, L.R. Radovic (Eds.), In Chemistry and Physics of Carbon, New York, Marcel Dekker, 2001, pp. 1-66, Vol. 27.
- [5] Y. Zhiyong, D. Laub, M. Bensimon, J. Kiwi, Inorg. Chim. Acta. 361 (2008) 589-594.
- [6] M. Qamar, M. Saquib, M. Muneer, Dyes. Pigments. 65 (2005) 1-9.
- [7] C. Namasivayam, R. Yamuna, T. Jayanthi, J. Cell. Chem. Technol. 37 (2003) 333-339.
- [8] R. Dhodapkar, N.N. Rao, S.P. Pande, S.N. Kaul, Bioresource Technol. 97 (2006) 877-885.
- [9] V.K. Gupta, A. Mittal, L. Kurup, J. Mittal, J. Colloid. Interf. Sci. 304 (2006) 52-57.
- [10] J.X. Lin, S.L. Zhan, M.H. Fang, X.Q. Qian, H. Yang, J. Environ. Manage. 87 (2008) 193-200.
- [11] B.H. Hameed, R.R. Krishni, S.A. Sata, J. Hazard. Mater. 162 (2009) 305-311.
- [12] A. Gürses, Ç. Doğar, M. Yalçın, M. Açıkyıldız, R. Bayrak, S. Karaca, J. Hazard. Mater. B131 (2006) 217-228.
- [13] M.Y. Teng, S.H. Lin, Desalination. 201 (2006) 201 71-81.
- [14] C. Bilgiç, J. Colloid. Interf. Sci. 281 (2005) 33-38.
- [15] G. Rytwo, C. Serban, S. Nir, L. Margulies, Clay. Clay Miner. 39 (1991) 551-555.
- [16] D. Aran, A. Maul, J.F. Masfaraud, C.R. Geoscience. 340 (2008) 865-871.
- [17] F. Favre, D. Tessier, M. Abdelmoula, J.M. Génin. W.P. Gates. P. Boivin, Eur. J. Soil. Sci. 53 (2002) 175-183.
- [18] I. Daou, R. Chfaira, O. Zegaoui, Z. Aouni, H. Ahlafi, Mediteer. J. Chem. 2 (2013) 569-582.
- [19] A. Viani, A.F. Gualtieri, G. Artioli, Am. Mineral. 87 (2002) 966-975.

- [20] Z.P. Tomić, V.P. Logar, B.M. Babic, J.R. Rogan, P. Makreski, Spectrochi. Acta A. 82 (2011) 389-395.
- [21] V.C Farmer, In Infrared Spectra of Minerals. Mineralogical Society. Farmer, V.C. Eds. London, UK, 1974.
- [22] J. Madejová, Vib. spectrosc. 31 (2003) 1-10.
- [23] V.S. Somerset, L.F. Petrik, R.A. White, M.J. Klink, D. Key, E. Iwuoha, Talanta. 64 (2004) 109-114.
- [24] J.T. Klopogge, E. Mahmutagic, R.L. Frost, J. Colloid Interf Sci. 296 (2006) 640-646.
- [25] P. Bankovic', A.M. Nikolic', Z. Mojovic', N.J. Jovicic', M. Perovic', V. Spasojevic', D. Jovanovic', Micropor. Mesopor. Mat.165 (2013) 247-256.
- [26] Z. Vukovic', A. Milutonic', L. Rožić, A. Rosić, Z. Nedić, D. Jovanović, Clay. Clay Miner. 54 (2006) 697-702.
- [27] V.C. Farmer, J.D. Russell, Clay Clay Miner. 15 (1967) 121-142.
- [28] F. Ayari, E. Srasra, M.T. Ayadi, Desalination. 185 (2005) 391-397.
- [29] S.G. Gregg, K.S.W. Sing, Adsorption. Surface Area and Porosity, 2nd Eds Academic Press, London, 1982.
- [30] M. Doğan, M. Alkan, A. Türkyilmaz, Y. Özdemir, J. Hazard. Mater. 109 (2004) 141-148.
- [31] C.A.P.Almeida, N.A. Debacher, A.J. Downs, L. Cottet, C.A.D. Mello, J. Colloid. Interf. Sci. 332 (2009) 46-53.
- [32] V. Vadivelan, K.V. Kumar, J. Colloid. Interf.Sci. 286 (2005) 90-100.
- [33] A. Tor, Y. Cengeloglu, J. Hazard. Mater. 138 (2006) 409-415.
- [34] Y. Seki, K. Yurdakoç, Adsorption 12 (2006) 89-100.
- [35] O. Hamdaoui, J. Hazard. Mater. B135 (2006) 264-273.
- [36] S. Chandrasekhar, P.N. Pramada Adsorption12 (2006) 27-43.
- [37] S. Lagergren, B.K. Svenska, Vetenskapsakademiens Handlingar 24 (1898) 1-39.
- [38] Y.S. Ho, G. McKay, Chem. Eng. J. 70 (1998) 115-124.
- [39] S. Tunali, A.S. Özcan, A. Özcan, T. Gedikbey, J. Hazard. Mater. 135 (2006) 141-148.
- [40] M. Doğan, M. Alkan, Ö. Demirbas, Y. Özdemir, C. Özmetin, Chem. Eng. J. 124 (2006) 89-101.
- [41] M. Doğan, M. Alkan, Y. Onganer, Water Air Soil Poll. 120 (2000) 229-248.

Appliquées à l'Environnement", Department of Chemistry. Faculty of Sciences, Moulay Ismail University, PB. 11201 Zitoun, Meknès, Morocco, Ikram.chimie@gmail.com

Second Author – Omar ZEGAOUI, Professor, Research Team: Materials and Applied Catalysis, Laboratory "Chimie-Biologie Appliquées à l'Environnement", Department of Chemistry. Faculty of Sciences, Moulay Ismail University, PB. 11201 Zitoun, Meknès, Morocco ozegaoui@gmail.com

Third Author – Rachid CHFAIRA, Professor, Research Team: Materials and Applied Catalysis, Laboratory "Chimie-Biologie Appliquées à l'Environnement", Department of Chemistry. Faculty of Sciences, Moulay Ismail University, PB. 11201 Zitoun, Meknès, Morocco, chfaira65@gmail.com.

Fourth Author – Hammou AHLAFI, Professor, Research Team: Materials and Applied Catalysis, Laboratory "Chimie-Biologie Appliquées à l'Environnement", Department of Chemistry. Faculty of Sciences, Moulay Ismail University, PB. 11201 Zitoun, Meknès, Morocco, hahlafi@yahoo.fr.

Fifth Author – Hamou MOUSSOUT, PhD student, Research Team: Materials and Applied Catalysis, Laboratory "Chimie-Biologie Appliquées à l'Environnement", Department of Chemistry. Faculty of Sciences, Moulay Ismail University, PB. 11201 Zitoun, Meknès, Morocco, moussouthammou@gmail.com

Correspondence Authors – Ikram DAOU, Email: ikram.chimie@gmail.com, Phone: +212 6 56 51 89 02. Or Omar ZEGAOUI, Email: ozegaoui@gmail.com

AUTHORS

First Author –Ikram DAOU, PhD student, Research Team: Materials and Applied Catalysis, Laboratory "Chimie-Biologie

The Study on Slum Population and Improvement Programs of Slums in Punjab

Dr. Balwinder Kaur

Associate Professor, Govt. College For Girls Patiala, Punjab

Abstract- The study covered Punjab state at District level. The Punjab, called Pentapotamia by the Greeks, derives its name from two Persian words, panj (five), an aab (water, having reference to the five rivers which confer on the country). Punjab also spelt Panjab, is a state in the northwest of the Republic of India, forming part of the larger Punjab region. The state is bordered by the Indian states of Himachal Pradesh to the east, Haryana to the south and southeast, Rajasthan to the southwest, and the Pakistani province of Punjab to the west. To the north it is bounded by the Indian state of Jammu and Kashmir. The state capital is located in Chandigarh, a Union Territory and also the capital of the neighbouring state of Haryana. The population is 24,289,296 (Census 2001)

Punjab is located in northwestern India, and has an area of 50, 362 sq.km. It extends from the latitudes 29.30° North to 32.32° North and longitudes 73.55° East to 76.50° East. It is bounded on the west by Pakistan, on the north by Jammu and Kashmir, on the northeast by Himachal Pradesh and on the south by Haryana and Rajasthan.

Most of the Punjab lies in a fertile, alluvial plain with many rivers and an extensive irrigation canal system.[33] A belt of undulating hills extends along the north eastern part of the state at the foot of the Himalayas. Its average elevation is 300 meters above sea level, with a range from 180 meters in the southwest to more than 500 meters around the northeast border. The southwest of the state is semiarid, eventually merging into the Thar Desert. The Shiwalik Hills extend along the north eastern part of the state at the foot of the Himalayas. A slum is a heavily populated urban informal settlement characterized by substandard housing

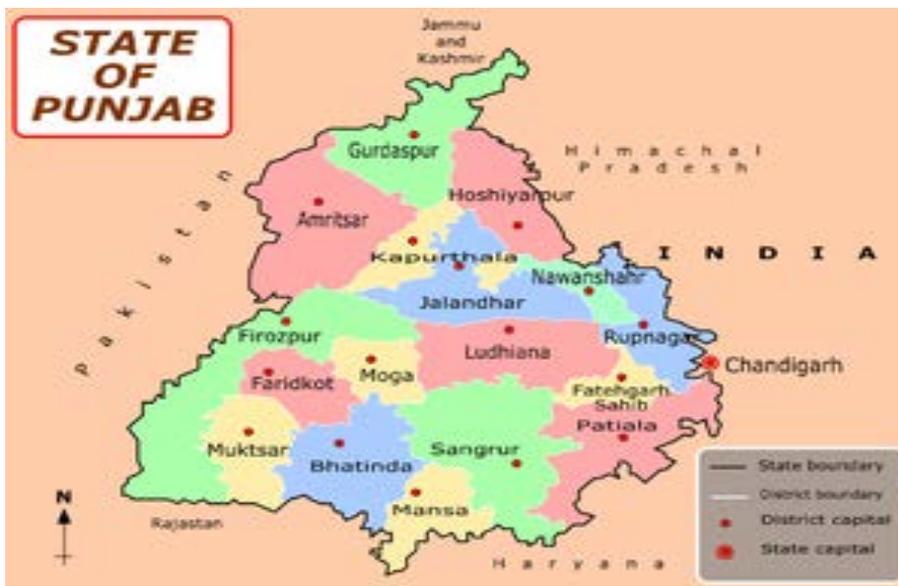
and squalor.[1] While slums differ in geographical pattern and other characteristics from country to country. There are many causes that create and expand slum population like : most lack reliable sanitation services, supply of clean water, reliable electricity, timely law enforcement and other basic services. Slum residences vary from shanty houses to professionally-built dwellings that because of poor-quality design or construction have deteriorated into slums. Increasing population of people residing in slums is a global problem. Several developing and developed countries are either facing this problem or they have faced it at one time or the other.

Index Terms- Slum population, geographical pattern, causes and expand of slum population.

I. INTRODUCTION

A **slum** is a heavily populated urban informal settlement characterized by substandard housing and squalor.^[1] While slums differ in size and other characteristics from country to country, most lack reliable sanitation services, supply of clean water, reliable electricity, timely law enforcement and other basic services. Slum residences vary from [shanty](#) houses to professionally-built dwellings that because of poor-quality design or construction have deteriorated into slums

Subdivisions



The area of Punjab can be divided into:

Malwa is a region of Punjab south to river **Sutlej**. The Malwa area makes up majority of the Punjab region consisting 11 districts. Cities such as **Ludhiana**, **Rupnagar**, **Patiala**, **Sangrur**, **Bathinda**, **Mansa**, **Firozpur**, **Fazilka**, **Rajpura**, **Moga** and **Ajitgarh** are located in the Malwa region. Malwa is also famous for cotton farming.

Majha is a historical region of the Indian Punjab comprising the modern districts of **Amritsar**, **Pathankot**, **Gurdaspur** and **Tarn Taran**. It lies between rivers **Ravi**, **Beas** and the **Sutlej**. This region is called

the heartland of Punjab and is celebrated as being the 'Cradle of **Sikhism**'.

Doaba is the region of Indian Punjab between the rivers **Beas** and **Sutlej**. The name "Doaba" literally translates to "land between two rivers" ("Do" two, "Ab" river; Punjabi). It is one of the most fertile regions of the world and was the centre of the Green Revolution in India. To this day, it remains one of the largest per capita producers of wheat in the world. The cities in Doaba are **Jalandhar**, **Hoshiarpur**, **Rupnagar**, **Nawanshahr** and **Kapurthala**.

Name of State/Union Territory	Statutory towns	Slum reported towns	Total population	Notified slums	Recognised slums	Identified slums
INDIA	4041	2613	65494604	22535133	193305	479517
Punjab	143	73	1460518	787696	20131336	22828135

Definition and types of slums – Census 2011 INDIA

(i) All notified areas in a town or city notified as 'Slum' by State, Union territories Administration or Local Government under any Act including a 'Slum Act' may be considered as Notified slums

(ii) All areas recognised as 'Slum' by State, Union territories Administration or Local Government, Housing and Slum Boards, which may have not been formally notified as slum under any act may be considered as Recognized slums

(iii) A compact area of at least 300 population or about 60-70 households of poorly built congested tenements, in unhygienic environment usually with inadequate infrastructure and lacking in proper sanitary and drinking water facilities. Such areas should be identified personally by the Charge Officer and also inspected by an officer nominated by Directorate of Census

Operations. This fact must be duly recorded in the charge register. Such areas may be considered as Identified slums

Source: Primary Census Abstract for Slum, 2011

Office of the Registrar General & Census Commissioner, India

II. STUDY AREA

The Present study covered Punjab state. Punjab, a region in Northern India and the east side of Pakistan, has a long history and rich cultural heritage. The people of the Punjab are called Punjabis and they speak a language called Punjabi. The three main religions in the area are Sikhism, Hinduism, and Islam.

Punjab is bounded on the north by the vast Himalyan ranges, which divide it from China, Tibet and Kashmir; on the east by the river Jamna, the North-Western Provinces and the Chinese Empire; on the south by Sind, the river Sutlej

III. OBJECTIVES

The proposed study will be carried out with the following objectives:-

- To Find out Distribution of Slum Population in Punjab
- To Find out Geographical Pattern of Slum Population in India and Punjab
- To Find out Causes create and expand Slum Population.
- To Find out Slum Improvement Programs.

IV. DATA SOURCE AND METHODOLOGY

The study has been carried out to obtain the above mentioned objectives. The present study has been conducted at district level and primarily based on secondary data, collected from Primary Census Abstract for Slum (2011), Punjab Statistical Abstract and Census of India 2011. An attempt has been made to highlight the data by using appropriate tables and maps. Data is

analyzed with the help of general statistical techniques and ARC GIS 9.3 software. :

Causes that create and expand slums

There are several reasons which increases slum population such as, the rural urban migration, urbanization, shortage of developed land for housing, rural migrants to the city in search of jobs, poverty and shortage of facilities and amenities, informal economy, politics, social conflicts and natural disasters etc. All these factors important play a role to enhancing slum population. These entire factors ratio are high in Sangrur District, Ferozpur, and Ludhiana so these districts serves high slum population

V. DISTRIBUTION AND GEOGRAPHICAL PATTERN OF SLUM POPULATION IN INDIA AND PUNJAB

In 2011, 73 slums reported towns in Punjab and 2613 in India. These towns have two type slum populations Notified slums 787696 in Punjab whereas 22535133 in India and Identified slums 47,9517 in Punjab and 22828135 in India. Largely, slum population has found in Industrialised area.



Slum population in Punjab

The slum population in the state is 20% of the total population. Urban poor housing needs are to be addressed considering future urbanisation, and greater migration into the cities.

Total Slum population in India

S No.	State / UT	Total Slum population		
		Persons	Males	Females
1	India	42,578,150	22,697,218	19,880,932
2	Andaman & Nicobar Is.	16,244	8,855	7,389
3	Andhra Pradesh	5,187,493	2,625,745	2,561,748
4	Assam	82,289	43,472	38,817
5	Bihar	531,481	282,772	248,709
6	Chandigarh	107,125	62,762	44,363
7	Chhatisgarh	817,908	422,096	395,812
8	Delhi	2,029,755	1,140,334	889,421
9	Goa	14,482	7,469	7,013
10	Gujarat	1,866,797	1,020,288	846,509
11	Haryana	1,420,407	778,734	641,673
12	Jammu & Kashmir	268,513	143,416	125,097
13	Jharkhand	301,569	158,532	143,037
14	Karnataka	1,402,971	714,413	688,558
15	Kerala	64,556	31,699	32,857
16	Madhya Pradesh	2,417,091	1,269,757	1,147,334
17	Maharashtra	11,202,762	6,137,624	5,065,138
18	Meghalaya	86,304	43,078	43,226
19	Orissa	629,999	330,054	299,945
20	Pondicherry	73,169	36,012	37,157
21	Punjab	1,159,561	629,326	530,235
22	Rajasthan	1,294,106	681,541	612,565
23	Tamil Nadu	2,866,893	1,441,437	1,425,456
24	Tripura	29,949	15,093	14,856
25	Uttar Pradesh	4,395,276	2,348,679	2,046,597
26	Uttranchal	195,470	103,895	91,575
27	West Bengal	4,115,980	2,220,135	1,895,845

Source: Census of India 2001

STATE SHARE OF SLUM POPULATION TO TOTAL SLUM POPULATION OF INDIA

2001

Maharashtra, 22.9
Andhra Pradesh, 12.0
Uttar Pradesh, 11.0
West Bengal, 8.9
Tamil Nadu, 8.1
Madhya Pradesh, 7.2
Karnataka, 4.5
NCT of Delhi #, 3.9
Gujarat, 3.8
Haryana, 3.2
Rajasthan, 3.0
Punjab, 2.8
Odisha, 2.1
Chhattisgarh, 2.1
Bihar, 1.6
Other State/UTs, 3.1

2011

Maharashtra, 18.1
Andhra Pradesh, 15.6
West Bengal, 9.8 Uttar Pradesh, 9.5
Tamil Nadu, 8.9
Madhya Pradesh, 8.7
Karnataka, 5.0 Rajasthan, 3.2 Chhattisgarh, 2.9
NCT of Delhi #, 2.7
Gujarat, 2.6 Haryana, 2.5
Odisha, 2.4
Punjab, 2.2
Bihar, 1.9
Other State/UTs, 3.8

Other States/UTs includes :

1. Reported slum less than 1.0%

Jammu & Kashmir, Uttarakhand, Jharkhand, Chandigarh #, Meghalaya, Assam, Puducherry #, Tripura and Kerala

2. State/UTs not reported slum

Himachal Pradesh, Sikkim, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Daman & Diu #, D & N Haveli #, Lakshadweep # and A & N Islands #

Other States/UTs

1. Reported slum less than 1.0%

Jammu & Kashmir, Uttarakhand, Jharkhand, Assam, Kerala, Tripura, Puducherry #, Himachal Pradesh, Chandigarh #, Nagaland, Mizoram, Nagaland, Mizoram, Meghalaya, Sikkim, Arunachal Pradesh, Goa and A & N Islands #

2. State/UTs not reported slum

Manipur, Daman & Diu #, D & N Haveli # and Lakshadweep #

Increasing population of people residing in slums is a global problem. Several developing and developed countries are either facing this problem or they have faced it at one time or the other. Punjab Slum Clearance Board (PSCB) and Jawahar Lal Nehru National Urban Renewal Mission (JNNURM) introduces and implemented many programmes for slum rehabilitation and development such as, Solid Waste Management, Shifting of Milk

Daries, Strengthening of Fire Services, Valmiki Ambedkar Malin Basti Awas Yojna, Low Cast Sanitation Scheme, Rajiv Awas Yojana (RAY) and Integrated Housing & Slum Development Programme. The target group under the scheme is slum dwellers. A sum of 2777.00 lacs is being provided in the Punjab State Plan Budget under this scheme during the year 2012-13.

Property Rights to slum dwellers

RAY: States /cities required to assign property Rights to slum dwellers. Tenure security is a major aspect of RAY

Every landless person shall be entitled to an affordable dwelling.

Minimum 25 sq m carpet area, or where land is being allotted - allow a construction of 25 sq m carpet area.

Slum Act: Punjab Slum Area (Improvement and Clearance) Act, 1961

The Act helps in:

- Declaration of slum areas
- Identifying Slum Areas for clearance

Definition of Slum: Any area where the buildings-

Are in any respect unfit for human habitation Are by reason of dilapidation, over crowding, faulty arrangements and design of such buildings, lack of ventilation, light or sanitation facilities are detrimental to safety, health or morals, it may, by notification in the official gazette, declare such area to be a slum area.

Issues to be Addressed:

Slum Act : Addresses Clearance- this approach has changed. Act needs to be redrafted.

Definition of Slum: State decision. For Punjab, things to be considered-

- Tenure status (as in RAY)- no Patta Act exists
- Special categorisation required for Industrial slum

VI. CONCLUSION

In 2001, 2.8 percent population lives in slums in Punjab but in 2011 there is only 2.2 percent persons lives in slum areas. There has been decreased 0.6 percent as compared 2001. Highest slum statutory towns are in Sangrur and second is Ferozpur and Ludhiana. Lowest statutory towns are in Tarn Taran District and Faridkot District . These districts have many factors to helpfor increasing slum population.

REFERENCES

- [1] Census of India 2001 and 2011
- [2] Condition of Slums in Punjab(2002). Economic & Statistical Adviser Planning Department, Punjab. Marimuthu, P. et al. (2009) General morbidity prevalence in the Delhi slums. Indian J Community Med.
- [3] Available from: <http://www.ijcm.org.in/text.asp?2009/34/4/338/58395>
- [4] Primary Census Abstract for Slum, 2011 Office of the Registrar General & Census Commissioner, India. Ranga, J.R. (1990). Punjab District Gazetteers. 10th Ed. Chandigarh: Punjab Gazetteers Organization
- [5] Report of committee on slum statistics/census ministry of housing and urban poverty alleviation directorate(NBO) & OSD
- [6] School of planning & Architect New Delhi
- [7] <http://www.wikipedia.org>
- [8] Revenue Department
- [9] Support to National Policies on Urban Poverty Reduction (a DFID and MHUPA Partnership) New Delhi

AUTHORS

First Author – Dr. Balwinder Kaur, Associate Professor, Govt. College For Girls Patiala, Punjab

An Approach to Detect and Correct Single Bit Data Error Using Reed_Muller Matrix

Monika Gope, Md. Ariful Islam Khandaker, Mehnuma Tabassum Omar

Department of Computer Science and Engineering
Khulna University of Engineering & Technology (KUET)
Khulna 9203, Bangladesh.

Abstract: Transferring data between two points is very crucial, also for some vital applications the precision of the transferred data is extremely important, however an error throughout the transmission of data is awfully familiar [1]. Error correcting codes are very valuable in transfer information over lengthy distances or through channels where errors might take place in the message. They have become more common as telecommunications have expanded and developed a use for codes that can auto-correct. Reed-Muller codes are a family of linear error correcting codes used in communications [2]. For bit error correction, the Reed-Muller code is one of the efficient algorithms, on the other hand, its high-computation prerequisite innate in the decoding process interdict its use in handy applications [3]. This paper describes a new method to detect and correct a single bit in the data message using Reed Muller matrix. The aim is to provide error-free information through transmitting and receiving by detection and correction a single bit in a big data very efficiently. The design detects and corrects all single bit errors in a 16, 32, 64, 128 bit data, and used 4, 5, 6, 7 check bits respectively. In the proposed method, it is feasible to detect the precise place of single bit error and correct that using least check bits.

Index Terms- Error Correction and detection, Reed Muller, Coding, Single bit error, Check bit

I. INTRODUCTION

In the present world, communication has got numerous applications such as telephonic conversations in which the messages are encoded into the communication channel and then decoding it at the receiver end [4]. Through data transmission, the arbitrary bit errors can be formed by ecological obstruction and material defects in the communication medium. Error coding is a technique of detecting and correcting these errors to make sure data is transferred unbroken from its source to its target. Computing in computer memory, magnetic and optical data storage technology, satellite, space and network communications, mobile networks, and almost any other form of digital data communication the error coding is used for fault tolerant. For communication error coding uses arithmetical formulas to encode data bits at the source into longer bit words and at the destination it decode the received bit words with the decoding method and determine the original message. The earlier approach uses Error-Correcting Codes and latter uses Error-detecting Codes [5]. A method is basically worthless if it does not assure

that the data received by one device are the same as the data transmitted by a different device. The main objective of this study is to devise a coding scheme which is able to detect and correct such errors [6].

The rest of the paper is prepared as follows. In section 2, we briefly describe the highlights of the background of the coding scheme used in this paper. Section 3 presents our algorithm for matrix generation and check bits generation, for all 16 bit, 32 bit, 64 bit, 128 bit (and so on) data with check bit respectively 4, 5, 6 (and so on). In section 4, we present our algorithms for error correction and detection, validating the mathematical model used in Section 3 for mitigating soft error. In section 5, we will analysis our results and showed relative efficiency of the other ECC schemes. Section 6 concludes the paper.

II. BACK GROUND OF THE CODING SCHEME

The technique for error detection and correction algorithms presented in this paper had been implemented by Reed-Muller matrix, which is used mostly to convert between Fixed Polarity Reed-Muller form and Boolean functions [8, 9]. The process is mainly divided into two parts. The algorithm which is relatively simple involves transmitting data with multiple check bits and decoding the associated check bits when receiving or when reading data from random access memory (RAM) to detect the errors [6]. By combing the exact data bits in the original message using XOR operator each check bits are generated. So at first we have generated the Reed-Muller matrix and then from the matrix we have to find out the check bit. The minimum number of check bits required to detect a single bit in the message is given by the following equation:

$$D+C+1 \leq 2r \quad (1)$$

Where D is the number of data bits and C is the number of check bits. Reed-Muller (RM) Codes are a family of linear error-correcting codes used in communications and are one of the oldest error correcting codes. On the other hand, error correcting codes play a significant function in computational complexity theory and are very functional in sending information over extensive distances in which errors might take place in the message [7]. This section describes a theory for encoding the message "the transmitted data" by using Reed-Muller basic matrix [10, 11]. In order to generate the Reed-Muller matrix for

$$\begin{aligned}
 C_{22} &= D_0 + D_2 + D_4 + D_6 + D_{16} + D_{18} + D_{20} + D_{22} \\
 C_{23} &= D_0 + D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_{16} + D_{17} + D_{18} + D_{19} + D_{20} + \\
 &D_{21} \\
 &+ D_{22} + D_{23} \\
 C_{24} &= D_0 + D_8 + D_{16} + D_{24} \\
 C_{25} &= D_0 + D_1 + D_8 + D_9 + D_{16} + D_{17} + D_{24} + D_{25} \\
 C_{26} &= D_0 + D_2 + D_8 + D_{10} + D_{16} + D_{18} + D_{24} + D_{26} \\
 C_{27} &= D_0 + D_1 + D_2 + D_3 + D_8 + D_9 + D_{10} + D_{11} + D_{16} + D_{17} + D_{18} + D_{19} + D_{24} \\
 &+ D_{25} + D_{26} + D_{27} \\
 C_{28} &= D_0 + D_4 + D_8 + D_{12} + D_{16} + D_{20} + D_{24} + D_{28} \\
 C_{29} &= D_0 + D_1 + D_4 + D_5 + D_8 + D_9 + D_{12} + D_{13} + D_{16} + D_{17} + D_{20} + D_{21} + D_{24} \\
 &+ D_{25} + D_{28} + D_{29} \\
 C_{30} &= D_0 + D_2 + D_4 + D_6 + D_8 + D_{10} + D_{12} + D_{14} + D_{16} + D_{18} + D_{20} + D_{22} + D_2 \\
 &4 + \\
 &D_{26} + D_{28} + D_{30} \\
 C_{31} &= D_0 + D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8 + D_9 + D_{10} + D_{11} + D_{12} + D \\
 &13 + \\
 &D_{14} + D_{15} + D_{16} + D_{17} + D_{18} + D_{19} + D_{20} + D_{21} + D_{22} + D_{23} + D_{24} + D_{25} + D_{26} \\
 &+ \\
 &D_{27} + D_{28} + D_{29} + D_{30} + D_{31}
 \end{aligned}$$

Now we need to calculate the check bits from the C0 to C31. As in this example we are working with 32 bit data, from equation (3), we find there are five check bits. This five check bits are calculated from the following equation

$$Q = 2^{C-1} \tag{5}$$

Where Q means how many 1's are in every check bit as the sum of 1 one column in the matrix and C = No. of Check bit, C. Those we have Q number of 1 in their column they are selected as check bit. So therefore, here C = 5 and Q = 16 which means from C₀ to C₃₁ who has 16 one, they should be selected as check bit. From the equation (3) and (5) we can derive the five check bit set which are as follows.

$$\begin{aligned}
 C_{15} &= D_0 + D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8 + D + \\
 &D_{10} + D_{11} + D_{12} + D_{13} + D_{14} + D_{15} \\
 C_{23} &= D_0 + D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + \\
 &D_{16} + D_{17} + D_{18} + D_{19} + D_{20} + D_{21} + D_{22} + D_{23} \\
 C_{27} &= D_0 + D_1 + D_2 + D_3 + D_8 + D_9 + D_{10} + D_{11} + D_{16} + \\
 &D_{17} + D_{18} + D_{19} + D_{24} + D_{25} + D_{26} + D_{27} \\
 C_{29} &= D_0 + D_1 + D_4 + D_5 + D_8 + D_9 + D_{12} + D_{13} + D_{16} + \\
 &D_{17} + D_{20} + D_{21} + D_{24} + D_{25} + D_{28} + D_{29} \\
 C_{30} &= D_0 + D_2 + D_4 + D_6 + D_8 + D_{10} + D_{12} + D_{14} + D_{16} + \\
 &D_{18} + D_{20} + D_{22} + D_{24} + D_{26} + D_{28} + D_{30}
 \end{aligned}$$

Now, we will denote C₁₅, C₂₃, C₂₇, C₂₉ and C₃₀ respectively to C₀, C₁, C₂, C₃ and C₄.

From equation (3) for 64 data bit, the no of check bit is 6 as 64 = 2⁶ and from the equation (5) the check bit set are as follows as each of the following contains 32 one in each column, C₃₁, C₄₇, C₅₅, C₅₉, C₆₁ and C₆₂.

Table 1: The Corresponding check bits for 32 data bit, D₀ to D₃₁

Data bits	Generated check bit				
	C ₀	C ₁	C ₂	C ₃	C ₄
D ₀	x	x	x	x	x
D ₁	x	x	x	x	
D ₂	x	x	x		x
D ₃	x	x	x		
D ₄	x	x		x	x
D ₅	x	x		x	
D ₆	x	x			x
D ₇	x	x			
D ₈	x		x	x	x
D ₉	x		x	x	
D ₁₀	x		x		x
D ₁₁	x		x		
D ₁₂	x			x	x
D ₁₃	x			x	
D ₁₄	x				x
D ₁₅	x				
D ₁₆		x	x	x	x
D ₁₇		x	x	x	
D ₁₈		x	x		x
D ₁₉		x	x		
D ₂₀		x		x	x
D ₂₁		x		x	
D ₂₂		x			x
D ₂₃		x			
D ₂₄			x	x	x
D ₂₅			x	x	
D ₂₆			x		x
D ₂₇			x		
D ₂₈				x	x
D ₂₉				x	
D ₃₀					x
D ₃₁					

IV. ALGORITHM FOR ERROR CORRECTION AND DETECTION:

Here we present the two algorithms for research of this paper for Error detection and correction for single data bit error.

Algorithm EDC: Error Detection for data bit error () {

1. Calculation of the Syndrome Code,
 Syndrome Code = Received Check bit XOR Receiver generated Received Check bit.
2. IF Syndrome Code contains only zero, then there is no Error detected in Received Check bit. Do nothing or Print NO Error.
3. IF Syndrome Code contains multiple one but not all one, Then Error detected in one of the Received Data bit. Print Error in Data bit.
4. IF Syndrome Code contains all one, Then Error detected in the first Received Data bit. Print Error D₀ Data bit.
 }

Algorithm ECC: Error Correction for data bit error () {

1. IF Error detected in the first Received Data bit, then inverse the first Received Data bit.
 2. IF Error detected in one of the Received Data bit, then the sum or weight of numerical value of the data bit is calculated by identified the zero-bits in the syndrome starting from the second bit left to right. These numerical values are zero and power of 2 as 2^N where $N = 0, 1, 2, 3...to C, C = No. of check bit.$
 3. After identified the position of error in the Received Data bit from 2, the data bit position is inversed.
- }

V. IMPLEMENTATION AND RESULT ANALYSIS:

In paper [6], they proposed the error correction and detection code for 16 data bit with 6 check bits. Here, in our research, we showed the method which will work on 16, 32, 64 and 128 data bits and the check bits required respectively 4, 5, 6 and 7 which will reduce the memory cost magnificently.

Our unique contribution of the paper is the equation (3) and (4) which we proposed here to identified the check bits.

Table 2: Identifying the check bits

2^C	Data Bits, D	Check bit, C	C contains 2^{C-1} s 1(one) in each Colum
2^4	16	4	8
2^5	32	5	16
2^6	64	6	32
2^7	128	7	64

In our Error Correction Code Algorithms which we proposed here is very faster than [6], as we introduced power of 2 to identify the error position where one of the Received Data bits are error.

From the algorithm we have simulated the error in data bit in our own simulator and find the result for 32 bit data, which is given in Table 3. Table 3 summarizes the process if one of the data bit become corrupted. Here the data massage = 01110011011001010101001101101101 and check bit = 01111. We get the Syndrome by the following equation:

$$\text{Syndrome} = \text{Received check bits} + \text{Recalculated/Receiver Generated Check bits} \quad (6)$$

Where “+” means XOR operation and we got recalculated check bits from equation (5).

Table 3: Syndrome with recalculated check bits and error bit position of the error data

Data	Received check bits $C_4 C_3 C_2 C_1 C_0$	Recalculated check bits $C_4 C_3 C_2 C_1 C_0$	Syndrome	Error bit position of data
D ₀	01111	10000	11111	0
D ₁	01111	00000	01111	1
D ₂	01111	11000	10111	2
D ₃	01111	01000	00111	1+2=3
D ₄	01111	10100	11011	4
D ₅	01111	00100	01011	1+4=5
.....				
D ₁₆	01111	10001	11110	16
D ₁₇	01111	00001	01110	1+16=17
D ₁₈	01111	11001	10110	2+16=18
D ₁₉	01111	01001	00110	1+2+16=19
D ₂₀	01111	10101	11010	4+16=20
.....				
D ₂₇	01111	01011	00100	1+2+8+16=27
D ₂₈	01111	10111	11000	4+8+16=28
D ₂₉	01111	00111	01000	1+4+8+16=29
D ₃₀	01111	11111	10000	2+4+8+16=30
D ₃₁	01111	01111	00000	1+2+4+8+16=31

To find the error in one of the check bits, the following Table 4 is used:

Table 4: Syndrome for error check bit

Check bit	Received check bits $C_4 C_3 C_2 C_1 C_0$	Recalculated check bits $C_4 C_3 C_2 C_1 C_0$	Syndrome	Error bit position of check bit
C ₀	01110	01111	00001	0
C ₁	01101	01111	00010	1
C ₂	01011	01111	00100	2
C ₃	00111	01111	01000	3
C ₄	11111	01111	10000	4

VI. CONCLUSION

In this paper we simply introduced a simple algorithm, which can be used to detect, and correct the errors in the transmitted data and check bit separately based on Reed-Muller matrix. The algorithm was tested on single bit error in our designed simulator and has found correct results for 16, 32, 64 and 128 data bits. In Future the algorithm can be extended to find more than single bit error.

REFERENCES

- [1] Pramod S P, Rajagopal A, Akshay S Kotain, 'FPGA Implementation of Single Bit Error Correction using CRC', *International Journal of Computer Applications (0975 – 8887) Volume 52– No.10, August 2012*
- [2] [2] Nidhi Syal, Vaneet Chahal, 'Comparison of "reed_muller and hamming codes" for error detection and correction', *ISP Journal of Electronics Engineering, Vol1, Issue 1, October'2011, (5-9)*
- [3] Md. Sharif Uddin, Cheol Hong Kim, Jong-MyonKim, 'Accelerating Soft-Decision Reed-Muller Decoding Using a Graphics Processing Unit', *Asia-pacific Journal of Multimedia Services Convergent with Art, Humanities, and Sociology Vol.4, No.2, December (2014), pp. 369-378*
- [4] Varsha P. Patil, Prof. D. G. Chougule, Radhika.R.Naik, 'Viterbi Algorithm for error detection and correction', *IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) ISSN: 2278-2834-, ISBN: 2278-8735, PP: 60-65*
- [5] Notes on 'Error Detection and Correction ', *Version 2 CSE IIT, Kharagpur*
- [6] Khalid Faraj, 'Design Error Detection and Correction System based on Reed_Muller Matrix for Memory Protection', *International Journal of Computer Applications (0975 – 8887) Volume 34– No.8, November 2011*
- [7] Othman O. Khalifa, Aisha-Huassan Abdullah, N. Suriyana, Saidah Zawanah and Shihab A. Hameed 'Reed-Muller Codec Simulation Performance', *Journal of Computer Science 4 (10): 792-798, 2008 ISSN 1549-3636*
- [8] Reed, I. S., 'Class of multiple error correcting codes and their decoding scheme', *Institute of Radio Engineers Transaction on Information Theory, PGIT-4: pp. 38- 49, 1954.*
- [9] Muller, D. E., 'Application of Boolean algebra to switching circuit design and to error detection', *Institute of Radio Engineers Transaction on Electronic Computers, EC-3: pp. 6-12, September 1954.*
- [10] Faraj, K., Almaini, A.E.A., 'Minimization of Dual Reed-Muller Forms using Dual Property' *WSEAS TRANSACTIONS on CIRCUITS and SYSTEMS, Issue 1, Vol. 6, pp.9-15, January 2007.*
- [11] Faraj, K., Almaini, A.E.A., 'Optimal Expression for Fixed Polarity Dual Reed-Muller Forms', *WSEAS TRANSACTIONS on CIRCUITS and SYSTEMS, Issue 3, Vol. 6, pp.9-15, March 2007.*

AUTHORS

First Author – Monika Gope, M.Sc (CSE ongoing), Khulna University of Engineering & Technology, gopenath14@yahoo.com.

Second Author – Md. Ariful Islam Khandaker, M.Sc(CSE ongoing), Khulna University of Engineering & Technology, aikhandaker@yahoo.com.

Third Author – Mehnuma Tabassum Omar, M.Sc(CSE ongoing), Khulna University of Engineering & Technology, misty2409@gmail.com.

Drying characteristics of Orthodox broken type tea

K. Raveendran*, A.D.U.S. Amarasinghe** and W.S. Botheju*

* Process Technology Division, Tea Research Institute of Sri Lanka

** Department of Chemical and Process Engineering, University of Moratuwa.

Abstract- Drying characteristic of Orthodox broken type tea was examined using a laboratory-scale fluid bed tea dryer. Drying experiments were carried out at loading of 29 kg/m² and moisture content of tea was reduced from 106% to 7% on dry basis. Hot air temperature was varied in the range of 108 - 127 °C as applicable for industrial type tea dryers. Semi-theoretical thin-layer drying models of Lewis, Henderson and Pabis, Logarithmic, Page, Modified Page and Two-term exponential model were tested. Page model gave better predictions than other models, and satisfactorily described drying characteristics of Orthodox broken type tea. Results suggested that internal mass transfer resistance has fully controlled the drying process after 4 minutes of drying. The effective diffusivity of water in tea during latter stage of drying was found to be 3.796 x 10⁻¹¹ (m/s) and 5.062 x 10⁻¹¹ (m/s) at hot air temperatures in the range of 108–121 °C and 124–127°C respectively. An empirical model was proposed to describe the variation of moisture content with tea-bed temperature and the predicted values were in close agreement with the measured data. The bulk density of the tea bed was found to increase with time and that might have reduced the channeling effect during latter stages of drying.

Index Terms- effective diffusivity, fluidized tea-bed, drying models, drying rate.

1. INTRODUCTION

Orthodox broken type tea is a special type of tea produced in 180 tea factories in Sri Lanka and exported mainly to Europe and Japan. Drying is important in tea manufacturing for partly to obtain the tea character and also to retain the tea character already achieved through early stages of the manufacturing process. Continuous type fluid bed tea dryers (FBD) are found to contribute effectively in this context.

Notable changes to tea manufacturing process was taken place in late nineties with the increased demand for Broken Orange Pekoe Fannings (BOPF) grade and as a result presently tea is manufactured with high percentage (more than 95%) of smaller size tea particles of less than 1 mm in size (Raveendran, et al, 2012). Consequently the effectiveness of the available fluid bed tea dryers became questionable. At present, many factories are experiencing difficulties in obtaining fluidization of tea with co-existence of continuous phase and bubble phase. Consequently, time to discharge from the dryer is affected and tea often get under-fired or over-fired and fine tea particles are carried over by the fluid stream leading to increased losses. Therefore, it is an essential requirement to study drying characteristics of Orthodox broken type tea with a view to improve fluidized bed drying.

In the past many theoretical, semi-theoretical and empirical models were developed for thin-layer drying of various foods and agro-based products. Theoretical models based on Fick's second law (Eq. [1]) takes into account only the internal resistance to moisture transfer. Therefore, this model is only useful in predicting the drying behaviour of regularly shaped food products such as hazelnuts (Demirtas et al, 1998) and rapeseed (Crisp & Woods, 1994).

$$\frac{\partial M}{\partial t} = D\nabla^2 M. \quad [1]$$

Semi-theoretical models are generally derived by simplifying general series solutions of Fick's second law or modification of simplified models. Lewis model (Eq. [2]), Henderson and Pabis model (Eq. [3]), Logarithmic model (Eq. [4]), Page model (Eq. [5]), modified Page model (Eq. [6]) and Two-term exponential model (Eq. [7]) are the widely used semi-theoretical thin-layer drying models (Botheju et al, 2011, Panchariya et al, 2002).

$$MR = \frac{M - M_e}{M_o - M_e} = \exp(-k_o t) \quad [2]$$

$$MR = \frac{M - M_e}{M_o - M_e} = A_o \exp(-k_o t) \quad [3]$$

$$MR = \frac{M - M_e}{M_o - M_e} = A_o \exp(-k_o t) + C \quad [4]$$

$$MR = \frac{M - M_e}{M_o - M_e} = \exp(-k_o t^n) \quad [5]$$

$$MR = \frac{M - M_e}{M_o - M_e} = \exp(-k_o t)^n \quad [6]$$

$$MR = \frac{M - M_e}{M_o - M_e} = A_o \exp(-k_o t) + A_1 \exp(-k_1 t) \quad [7]$$

Where MR is the moisture ratio; M is the average moisture content in percentage (w/w, dry basis) at drying time t; M_o is the initial moisture content in percentage (w/w, dry basis); M_e is the equilibrium moisture content in percentage (w/w, dry basis); A_o, k_o, A₁, k₁ and n are the empirical coefficients.

Botheju et al. (2011) performed a regression analysis for various semi-theoretical models on their single layer drying data and suggested the Two-term model (Eq. [7]) as the most appropriate for drying fresh tea leaves. In several other studies the semi-theoretical thin-layer drying models were successfully used to describe the drying phenomenon of many products such as apple pomace (Zhengfu Wang et al, 2007), rough rice with high moisture content (Chiachung Chen & Po-Ching Wu.,2001), pistachio nuts (Kashaninejad et al, 2007), chicory root slices (Lee et al, 2004), garlic slices (Ponciano et al, 1996), pre-dried young coconut (Ponciano, 2003) and quercus (Tahmasebi et al, 2011). In tea manufacturing, due to severe maceration on leaf, a large number of cells are ruptured, cell sap has been mixed and there is a good accessibility for gas exchange within the particles of leaf (Temple & Van Boxtel, 1999a). Therefore, evaporation of water enhances due to increased surface area resulting in reducing the role of diffusion within the particle relative to the surface and air boundary layer resistance. Temple & Van Boxtel (1999b) studied drying rate kinetics of “Cutting, Tearing and Curling” tea (CTC tea) considering Lewis model with an assumption that the resistance for water vapour transport is all over the surface of the particle. They varied the drying temperature between 50 and 150°C. Panchariya et al, (2002) studied thin-layer drying characteristics of CTC tea produced in India at drying air temperatures in the range of 80–120°C. They found that drying is dominated in the falling rate period and Lewis model gave better predictions for CTC tea compared to other widely used semi-theoretical thin-layer drying models. The objective of the present study is to establish the drying characteristics of Orthodox broken type tea and to identify suitable drying model for describing its drying behaviour.

2. MATERIALS AND METHODS

2.1 EXPERIMENTAL APPARATUS

2.1.1 LABORATORY-SCALE FLUID BED TEA DRYER

Tea samples were dried using a laboratory-scale fluid bed tea dryer unit (Teacraft, UK). The unit was fixed with a cylindrical loading vessel (diameter 10cm and height 48cm) fabricated with transparent material (Figure 1). The loading vessel was covered using a lid fitted with nylon net to avoid entrainment of tea particles. Temperature was controlled by a PID controller with an accuracy of ± 1 °C. Inlet hot air temperature could be varied between 100 and 150 °C. Fluidization of tea with co-existence of continuous phase and bubble phase was obtained in the unit by changing air flow rate.

2.1.2 ECM (ENVIRONMENTALLY CONTROLLED MANUFACTURE) UNIT

The ECM Unit (model TMC 185/CRP-15, Teacraft, UK) consists of a purpose built environmentally controlled chamber with extremely tight control over temperature and humidity (controlled to ± 0.1 °C and ± 0.1% RH). The chamber incorporates a sealed refrigeration unit, modulated electric heating and a water vaporizing system coupled with a programmable control unit that can maintain the required set conditions of 15 –25 °C and up to 98% RH. The ECM unit (Figure 2) was used to keep tea samples without losing its moisture content.



Figure 1 : Fluid bed tea dryer



Figure 2 : ECM unit

2.2 EXPERIMENTAL MATERIAL

Partly fermented tea samples with a moisture content of 106 % (w/w, dry basis) were obtained from a typical tea factory and used in this study.

2.3 EXPERIMENTAL PROCEDURE

Generally green tea leaves undergo four series of processes named, withering, rolling, roll-breaking and fermentation before it is dried. Eight kilograms of partly fermented tea were collected and packed in eight separate polythene bags to contain 1 kg each. The polythene bags were then placed in ECM unit after setting both dry and wet bulb temperatures at 20 °C to maintain the same moisture level in tea samples. Initial moisture content was determined by oven drying of 25 g sample at 103 ± 2 °C. Loading of 29 kg/m² was selected on the basis of maximum possible loading to obtain fluidization with co-existence of continuous phase and bubble phase for Orthodox broken type tea with modified bedplates in industrial type fluid bed tea dryers (Raveendran et al, 2012). In order to have this loading, the loading vessel of the laboratory-scale fluid bed tea dryer was loaded with 250g of tea sample. The dryer unit was set to deliver hot air at 127 °C and a k-type thermocouple probe was placed in the loading vessel at a height of 7 cm to measure tea-bed temperature. Another thermocouple was placed at a height of 30 cm to measure exhaust temperature. Both the temperature and the moisture content were measured at 1-minute intervals. Experiment was continued until the tea-bed temperature reached 102 - 104 °C at which moisture content in tea reached the final level of 5 - 7% (w/w, dry basis). Moisture content in dried tea was determined by oven drying of 25 g sample at 103 ± 2 °C. The experiment was then repeated for eight different hot air temperatures in the range of 108 – 127 °C. This temperature range includes hot air temperature of 124 – 127 °C that is being practiced in fluid bed tea dryers in tea factories at present.

2.4 DATA ANALYSIS

Drying data were fitted to different semi-theoretical thin-layer drying models (Eq. [2] to [7]). Non-linear regression analysis was used to estimate the empirical constants of all the models starting with a set of initial values estimated from the corresponding linearized form. Several criteria for adequacy of fit such as correlation coefficient (R^2), root mean square error (RMSE, Eq. [8]) and reduced chi-square (χ^2 , Eq. [9]) were used to select appropriate model for Orthodox broken type tea. The model with the least root mean square and reduced chi-square and the highest coefficient of correlation was selected as the best fit.

$$RMSE = \left[\frac{1}{N} \sum_{i=1}^N (MR_{exp,i} - MR_{pre,i})^2 \right]^{\frac{1}{2}} \quad [8]$$

$$\chi^2 = \frac{\sum_{i=1}^N (MR_{exp,i} - MR_{pre,i})^2}{N - m} \quad [9]$$

3. RESULTS AND DISCUSSION

Variation of moisture content with drying time and the drying rate versus drying time for fermented tea dried at different hot air temperatures are shown in Figures 3 and 4 respectively. Drying rate was calculated as the amount of moisture evaporated per kg of dry tea within a unit time of 1 minute. Even though the drying experiments were performed for eight different hot air temperatures, the results of only four hot air temperatures, (108, 116, 124 & 127 °C) are shown in Figures for clarity.

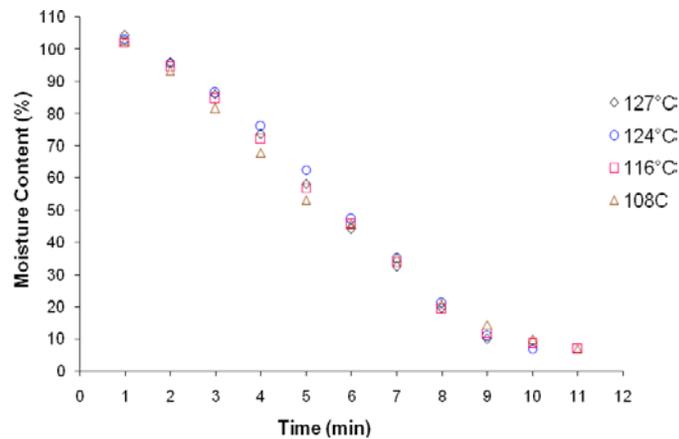


Figure 3 : Variation of moisture content with drying time

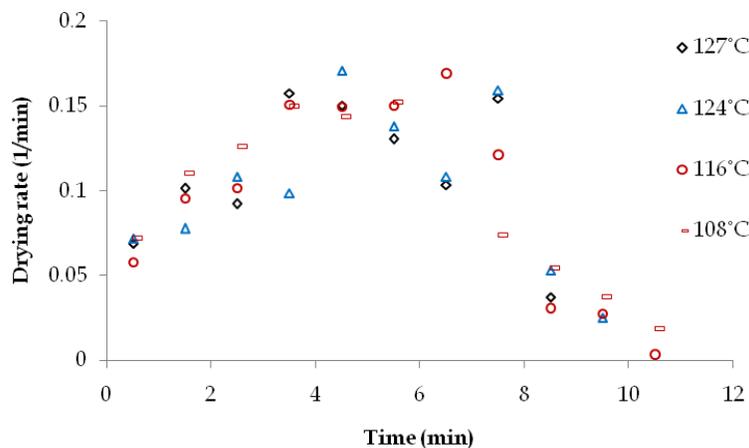


Figure 4 : Drying rate versus drying time

Variation of drying rate with time was very similar in nature for all different hot air temperatures examined in the present study. The initial drying rate was low due to the presence of sticky tea particles with high moisture content that prevented intensive mixing with hot air. The notable increase in drying rate at the beginning (as depicted in Figure 4) may be attributed to removal of surface moisture with time. The presence of surface moisture is also confirmed with the observation of marginal increase in tea-bed temperature (as shown in Figure 5) during first 4 minutes of drying. Figure 6 shows constant rate and falling rate periods after the period of increasing drying rate. Therefore it further confirms that surface moisture was available in tea when the moisture content was above 60% (w/w dry basis). A final moisture level in tea of 5 - 7% (w/w dry basis) was achieved within a short period of 10 - 11 minutes

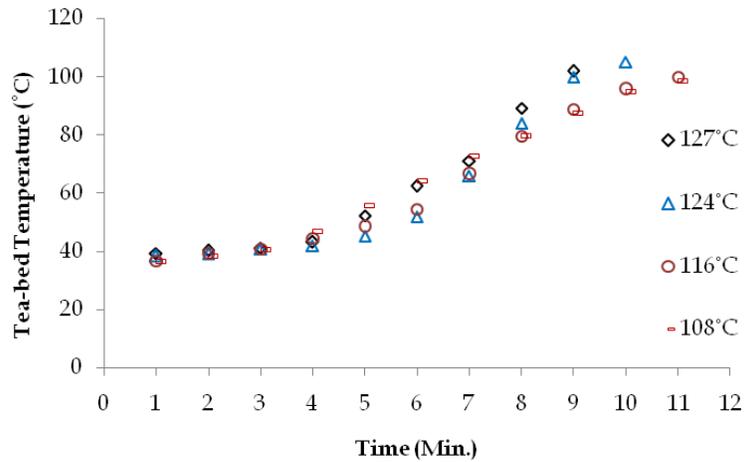


Figure 5: Tea-bed temperature versus drying time

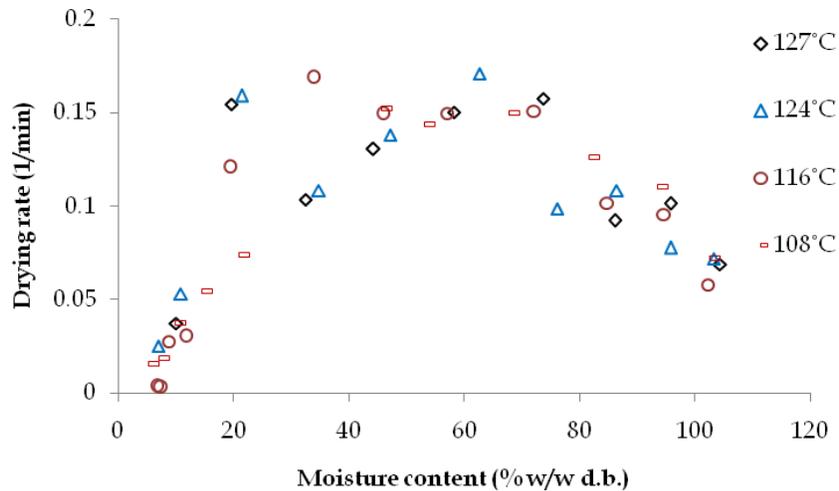


Figure 6 : Drying rate versus moisture content of tea

A typical characteristic drying curve (moisture ratio vs. time) for orthodox broken type tea is shown in Figure 7. Equilibrium moisture content was taken as zero in the calculation of moisture ratios for hot air temperatures over 100 °C as explained by Temple & van Bostel (1999). Drying data were fitted to six different semi-theoretical thin-layer drying models (Eq. [2] to [7]). The results of the analysis in evaluating the models based on correlation coefficient (R^2), root mean square error (RMSE) and reduced chi-square (χ^2) are presented in Table 1. Results indicate that semi-theoretical thin-layer drying models under investigation were in good correlation with the experimental data and Page model gave the best fit with a correlation coefficient above 0.99 for all the hot air temperatures. The RMSE and χ^2 values were less than 0.0319 and 1.02×10^{-3} respectively. Since the semi-theoretical thin-layer models under investigation were derived using Fick's Law as the basis, internal resistance to moisture transfer was considered to be dominant.

Table 1 : Results of analysis in evaluating different thin-layer drying models

Model	T (°C)	Constants			R ²	RMSE	χ ²
Lewis	127	k ₀ = 0.16628			0.9652	0.1150	1.32x10 ⁻²
	126	k ₀ = 0.16477			0.9713	0.1024	1.05x10 ⁻²
	124	k ₀ = 0.16389			0.9582	0.1246	1.55x10 ⁻²
	121	k ₀ = 0.14346			0.9661	0.1192	1.42x10 ⁻²
	118	k ₀ = 0.14729			0.9605	0.1195	1.43x10 ⁻²
	116	k ₀ = 0.17045			0.9734	0.1122	1.26x10 ⁻²
	112	k ₀ = 0.18171			0.9881	0.0819	6.70x10 ⁻³
	108	k ₀ = 0.17481			0.9796	0.0936	8.76x10 ⁻³
Henderson and Pabis	127	k ₀ = 0.21933	A ₀ = 1.27694		0.9431	0.0835	6.97x10 ⁻³
	126	k ₀ = 0.20995	A ₀ = 1.24768		0.9523	0.0751	5.63x10 ⁻³
	124	k ₀ = 0.21557	A ₀ = 1.29172		0.9336	0.0941	8.85x10 ⁻³
	121	k ₀ = 0.18922	A ₀ = 1.28546		0.9435	0.0848	7.19x10 ⁻³
	118	k ₀ = 0.19193	A ₀ = 1.27551		0.9377	0.0891	7.94x10 ⁻³
	116	k ₀ = 0.22299	A ₀ = 1.30227		0.9555	0.0765	5.86x10 ⁻³
	112	k ₀ = 0.22558	A ₀ = 1.23572		0.9760	0.0527	2.78x10 ⁻³
	108	k ₀ = 0.22094	A ₀ = 1.25545		0.9658	0.0637	4.06x10 ⁻³
Logarithmic	127	k ₀ = 0.02034	A ₀ = 6.25854	C = -5.17215	0.9932	0.0302	9.12x10 ⁻⁴
	126	k ₀ = 0.04303	A ₀ = 3.00384	C = -1.92960	0.9947	0.0257	6.60x10 ⁻⁴
	124	k ₀ = 0.03875	A ₀ = 3.87471	C = -2.77432	0.9867	0.0432	1.86x10 ⁻³
	121	k ₀ = 0.03314	A ₀ = 3.58197	C = -2.47156	0.9907	0.0351	1.23x10 ⁻³
	118	k ₀ = 0.03339	A ₀ = 3.55569	C = -2.45584	0.9871	0.0413	1.71x10 ⁻³
	116	k ₀ = 0.10366	A ₀ = 1.69816	C = -5.39383	0.9822	0.0492	2.42x10 ⁻³
	112	k ₀ = 0.12299	A ₀ = 1.47724	C = -3.62512	0.9945	0.0255	6.48x10 ⁻⁴
	108	k ₀ = 0.11111	A ₀ = 1.26964	C = -4.44513	0.9872	0.0397	1.58x10 ⁻³
Page	127	k ₀ = 0.03545	n = 1.91457		0.9947	0.0262	6.86x10 ⁻⁴
	126	k ₀ = 0.04408	n = 1.75158		0.9920	0.0307	9.44x10 ⁻⁴
	124	k ₀ = 0.02742	n = 2.01632		0.9941	0.0294	8.67x10 ⁻⁴
	121	k ₀ = 0.02350	n = 1.97246		0.9971	0.0197	3.88x10 ⁻⁴
	118	k ₀ = 0.02394	n = 1.98095		0.9961	0.0239	5.71x10 ⁻⁴
	116	k ₀ = 0.03714	n = 1.86054		0.9947	0.0259	6.74x10 ⁻⁴
	112	k ₀ = 0.06743	n = 1.56911		0.9977	0.0160	2.57x10 ⁻⁴
	108	k ₀ = 0.05665	n = 1.63947		0.9908	0.0319	1.02x10 ⁻³
Modified Page	127	k ₀ = 0.39644	n = 0.39644		0.9621	0.1161	1.35x10 ⁻²
	126	k ₀ = 0.39791	n = 0.39792		0.9687	0.1047	1.10x10 ⁻²
	124	k ₀ = 0.40484	n = 0.40485		0.9582	0.1321	1.75x10 ⁻²
	121	k ₀ = 0.37874	n = 0.37877		0.9661	0.1257	1.58x10 ⁻²
	118	k ₀ = 0.38382	n = 0.38374		0.9605	0.1259	1.59x10 ⁻²
	116	k ₀ = 0.40843	n = 0.40842		0.9710	0.1213	1.47x10 ⁻²
	112	k ₀ = 0.42203	n = 0.42204		0.9871	0.0864	7.47x10 ⁻³
	108	k ₀ = 0.41821	n = 0.41821		0.9866	0.0959	9.19x10 ⁻³
Two-term exponential	127	k ₀ = 0.22084	k ₁ = 0.21971	A ₀ = 0.66164 A ₁ = 0.61779	0.9413	0.1009	1.02x10 ⁻²
	126	k ₀ = 0.03635	k ₁ = 0.00865	A ₀ = 4.33212 A ₁ = -3.25756	0.9947	0.0277	7.66x10 ⁻⁴
	124	k ₀ = 0.00396	k ₁ = -0.02132	A ₀ = 5.06993 A ₁ = -4.00522	0.9929	0.0337	1.14x10 ⁻³
	121	k ₀ = 0.18912	k ₁ = 0.18928	A ₀ = 0.64258 A ₁ = 0.64282	0.9435	0.0962	9.25x10 ⁻³
	118	k ₀ = 0.00596	k ₁ = 0.02918	A ₀ = -3.74482 A ₁ = 4.84565	0.9872	0.0441	1.94x10 ⁻³
	116	k ₀ = 0.22722	k ₁ = 0.22227	A ₀ = 0.23613 A ₁ = 1.06684	0.9554	0.0868	7.53x10 ⁻³
	112	k ₀ = 0.22500	k ₁ = 0.22617	A ₀ = 0.62833 A ₁ = 0.60738	0.9760	0.0598	3.57x10 ⁻³
	108	k ₀ = 0.22018	k ₁ = 0.22132	A ₀ = 0.42365 A ₁ = 0.83179	0.9658	0.0722	5.21x10 ⁻³

Panchariya et al. (2002) used general series solution of Fick's second law in spherical coordinates as given in Eq. [10] to describe drying of CTC black tea (average diameter of 500 μm). Constant diffusivity and spherical tea particles were the assumptions that he made in the equation where D_{eff} is the effective diffusivity (m²/s) and R is the radius of the tea particles (m). Orthodox broken type tea produced at present also has particles in the range of 355 to 710 μm. Therefore, Eq. (10) was also examined for describing drying behaviour of Orthodox broken type tea as well.

$$\frac{M - M_e}{M_o - M_e} = \frac{6}{\pi^2} \sum_{n=1}^{\infty} \frac{1}{n^2} \exp\left(-\frac{n^2 D_{eff} \pi^2}{R^2} t\right) \dots [10]$$

The first term of Eq. [10] is also known as the Henderson and Pabis model. The slope, coefficient k , of this model is related to the effective diffusivity as given in Eq. [11].

$$k = \frac{D_{eff} \pi^2}{R^2} \quad \dots [11]$$

The effective diffusivity of water was calculated using the slope of Eq. [10] and deduced from the linear regression of $\ln(MR)$ versus time as shown in Figure 8. Initially up to 4 minutes, the effective diffusivity varied between 6.327×10^{-12} and $2.531 \times 10^{-11} \text{ m}^2/\text{s}$ for all the hot air temperatures. During the final stage of drying, it was $3.796 \times 10^{-11} \text{ m}^2/\text{s}$ at hot air temperatures of 108-121 °C and $5.062 \times 10^{-11} \text{ m}^2/\text{s}$ at hot air temperatures of 124-127 °C. This confirms that interaction between tea particles and hot air is difficult in tea-bed during early stages and then internal mass transfer resistance fully controlled the drying behaviour during the final stages of drying.

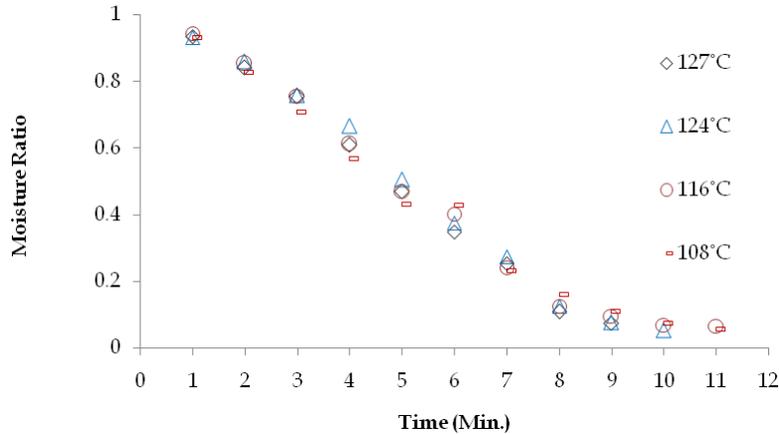


Figure 7 : Variation of moisture ratio with time

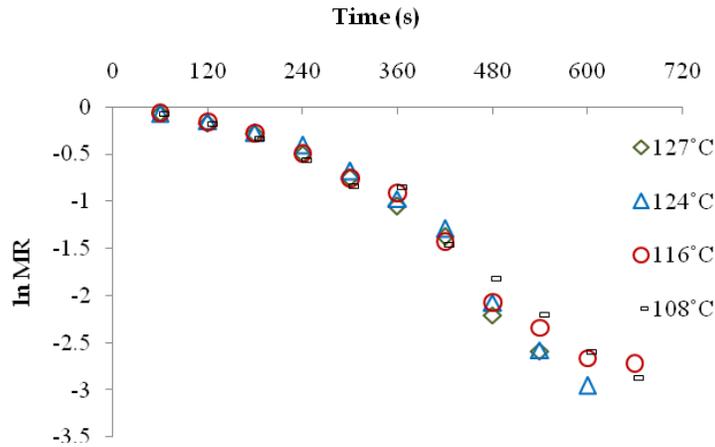


Figure 8 : Experimental logarithmic moisture ratio at different drying time

In industrial type fluid bed tea dryers, tea-bed temperature is monitored as one of the drying parameters to control the drying process. Variation of moisture content with tea-bed temperature was studied for the maximum and minimum hot air temperatures currently in operation with industrial dryers (124 & 116 °C). An empirical equation (Eq. [12]) has been proposed to describe the variation of moisture content with tea-bed temperature. MC is the moisture content and T is Tea-bed temperature. The values of empirical constants a and b are 1.619266×10^6 and -2.322 respectively. The predicted and measured moisture contents are presented in Figures 9 and 10. The predicted values are found to be in close agreement with the measured values with correlation coefficients of 0.987 and 0.996 respectively.

$$MC = (aT^b) / \ln(T) \quad \dots [12]$$

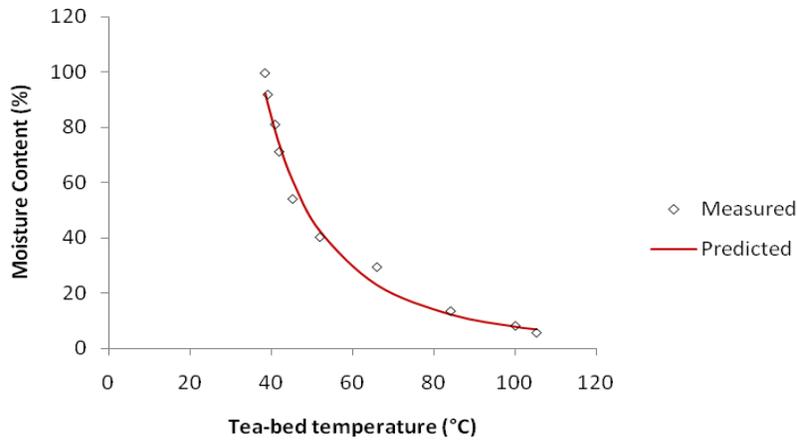


Figure 9 : Measured and predicted moisture content for the hot air temperature of 124 °C

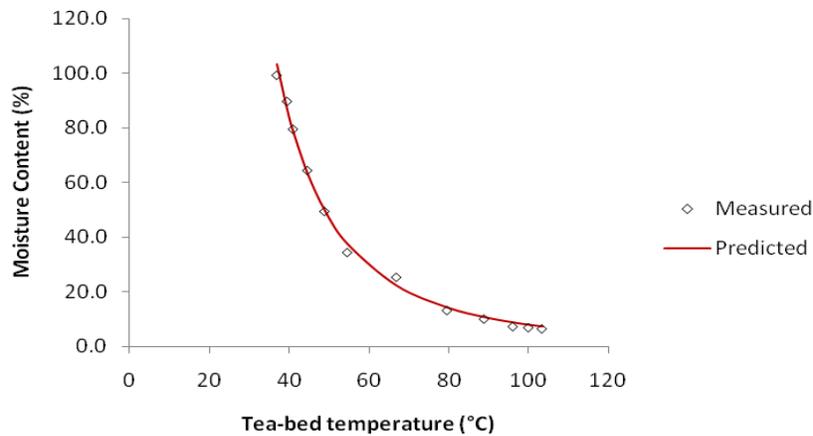


Figure 10 : Measured and predicted moisture content for the hot air temperature of 116 °C

Tea particle shrinks with time as it loses its moisture. As a result the bulk density varies with time. Variation of bulk density with time for tea dried at 124 °C was compared with tea dried at 116 °C as shown in Figure 11. Shrinking rate of tea particles would have been higher at 124 °C compared to that at 116 °C, especially after about 4 minutes of drying when most of the surface moisture is expected to be removed. This might have increased the bulk density during drying at 124 °C. The variation in the bulk density would have influenced fluidizing behaviour of tea and helped reducing channelling effect during final stage of drying.

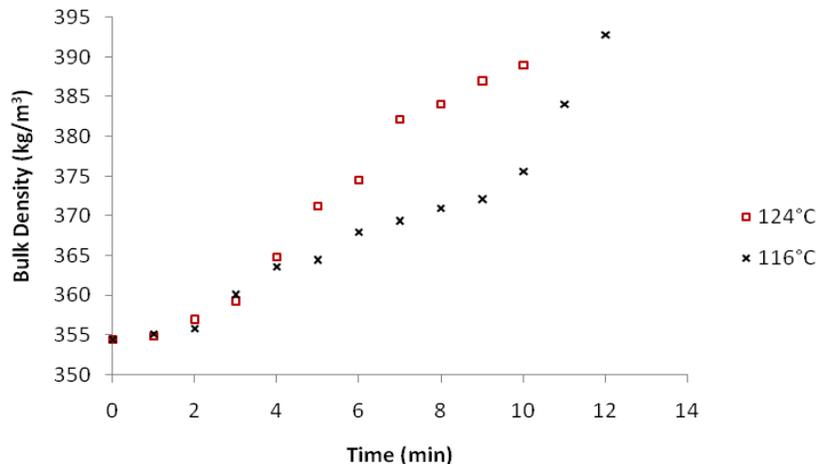


Figure 11 : Variation of bulk density of tea with time during drying

4. CONCLUSIONS

Drying curves for orthodox broken type tea were obtained by using a laboratory scale fluid bed tea dryer. The drying behavior was found to be very similar in the range of hot air temperatures from 108 – 127 °C. However, temperature and bulk density of the tea-bed were changing notably with the increase of hot air temperature after 4 minutes of drying time. Drying rate increased notably with time at initial stages and decreased sharply at final stages of drying to achieve the final moisture content of 5- 7% (w/w, dry basis). A short constant rate period was observed in between. Surface moisture was found to be present in tea with moisture contents above 60% (w/w dry basis). Drying characteristics of orthodox broken type tea was best described by Page thin-layer drying model. Effective diffusivity of water was found to be constant during final stage of drying with the values of 3.796×10^{-11} and 5.062×10^{-11} m²/s within the range of hot air temperatures 108 – 121 °C and 124 – 127 °C respectively. The variation of moisture content with tea-bed temperature could be successfully predicted by the empirical equation $MC = (aT^b) / Ln(T)$. The bulk density of tea-bed was found to increase with drying time and this might have influenced the reduction of channeling effect in tea-bed during latter stages of drying.

REFERENCES

- [1] Botheju W S, Amarathunge, K S P and Abeysinghe, I S B, 2011. Thin layer characteristics of fresh tea leaves. J.Natn.Sci.Foundation. Sri Lanka, 39(1): 61-67.
- [2] Chiachung Chen, and Po-Ching Wu, 2001. Thin-layer Drying model for rough rice with high moisture content. J. agric. Eng Res., 80(1): 45-52.
- [3] Crisp J. and Woods J. L., 1994. The drying properties of rapeseed. J. agric. Eng. Res., 57(2): 89-97.
- [4] Demirtas C, Ayhan T and Kaygusuz K, 1998. Drying behaviour of hazelnuts. Journal of the science of food and Agriculture, 76(4):559-564.
- [5] Kashaninejad M, Mortazavi A, Safekordi A and Tabil L G, 2007. Thin-layer drying characteristics and modelling of pistachio nuts. Journal of Food Engineering, 78(1): 98-108.
- [6] Lee G, Kang W S and Hsieh F, 2004. Thin-Layer drying characteristics of Chicory root slices. Transactions of the ASAE, Vol. 47(5): 1619-1624.
- [7] Panchariya P C, Popovic D and Sharma A L, 2002. Thin Layer modeling of black tea drying process. Journal of Food Engineering, 52(4): 349-357.
- [8] Ponciano S M, Robert H D and Ken A B, 1996. The thin-layer drying characteristics of galic slices. Journal of Food Engineering, 29(1): 75-97.
- [9] Ponciano S M, 2003. Thin layer drying models for osmotically pre-dried young coconut. Drying technology, 21(9): 1759-1780.
- [10] Raveendran K, Amarasinghe A D U S and Botheju W S, 2012. Fluidization behaviour of Orthodox-rotorvane teas. Proceedings of 4th Plantation crop symposium, 283-293.
- [11] Tahmasebi M, TavakkoliHashjin T, Khoshtaghaza M H and Nikbakht A M, 2011. Evaluation of Thin-Layer Drying Models for simulation of drying kinetics of Quercus (Quercuspersica and Quercuslibani). J. Agr. Sci. Tech, 13(2): 155-163.
- [12] Temple S J and Van Boxtel A J B, 1999a. Equilibrium moisture content of tea. J. Agric. Eng. Res, 74(1): 83-89.
- [13] Temple S J and Van Boxtel A J B, 1999b. Thin layer drying of black tea. J. Agric. Eng Res, 74(2): 167-176.
- [14] Zhengfu Wang, Junhong Sun, Xiaojun Liao, Fang Chen, Guanghua Zhao, Jihong Wu, and Xiaosong Hu, 2007. Mathematical modelling on hot air drying of thin layer apple pomace. Food Research International, 40(1): 39-46.

AUTHORS

First Author - K.Raveendran, B.Sc.Eng. (Moratuwa, Sri Lanka), M.Eng. (Thailand), Senior Research Officer, Tea Research Institute of Sri Lanka.

Second Author - A.D.U.S. Amarasinghe, B.Sc. Eng. (Moratuwa, Sri Lanka), PhD (Cambridge), Senior Lecturer, Department of Chemical and Process Engineering, University of Moratuwa, Sri Lanka.

Third Author - W.S. Botheju, B.Sc. (Colombo, Sri Lanka), M.Phil. (Peradeniya, Sri Lanka), PhD (Peradeniya, Sri Lanka), Principal Research Officer, Tea Research Institute of Sri Lanka.

Correspondence Author –A.D.U.S. Amarasinghe, shanthamrt@gmail.com, +94773064604.

Association of Serum Uric Acid and Neuropathy in Pre-diabetic and Diabetic subjects in North Indian Population

Radhey Shyam¹, Pushalata Sachan², Munna Lal Patel³, Shradha Singh² and Sunita Tiwari²

¹Department of Geriatric Mental Health, King George's Medical University, Uttar Pradesh, Lucknow, India

²Department of Physiology, King George's Medical University, Uttar Pradesh, Lucknow, India

³Department of Medicine, King George's Medical University, Uttar Pradesh, Lucknow, India

Abstract- Background: Diabetes is a metabolic condition with inappropriate hyperglycemia either due to deficiency of insulin secretion or resistance to insulin or both. It is also associated with disturbances concerned with protein, carbohydrate, and lipid metabolism. Thus we had estimated the Level of serum Uric Acid and it's association with neuropathy in pre-diabetics and diabetics from northern India.

Method: This is an observational study and total 79 subjects were enrolled as per American Diabetic Association (ADA) Guidelines 2010. Out of 79 subjects, 16 subjects were Pre-Diabetic and 63 subjects were Diabetic. Serum uric acid was estimated by using MERK Kit with the help of semi-automated analyzer. Estimation of Neuropathy was done by Nerve Conduction Studies.

Result:

- The Serum uric acid level of Diabetic group was lower as compared to Pre diabetic group. ($p < 0.001$)
- In diabetics upper extremity sensory nerve conduction velocity were significantly lowered as compared to prediabetic, while in lower extremity the difference was statistically not significant.
- In lower extremity motor nerve conduction velocity was significantly lower in diabetics than prediabetics. We concluded that motor abnormalities more in diabetics as compared to prediabetics.
- Serum uric acid of Pre diabetics negatively (inverse) and significantly correlated with neuropathy in left Sural nerve (Velocity) ($r = -0.60$, $p < 0.05$). In prediabetic subjects serum uric acid level was higher and neuropathy was not observed.

Conclusion: In prediabetics serum uric acid level might be useful for prediction of diabetes. Though the neuropathy was more common in diabetics but it also affect the prediabetics.

Index Terms- Diabetes, Prediabetes, Serum Uric Acid, Nerve conduction velocity, Neuropathy

I. INTRODUCTION

Diabetes is a metabolic disorder with inappropriate hyperglycemia either due to deficiency of insulin secretion or reduction in the biologic effectiveness of insulin or both.

International Diabetic Federation data shows that world Diabetes & Pre-diabetes prevalence in 2007 is 5.7% and 7.5% respectively. In India Diabetes Mellitus prevalence ranges from 0.4 to 3.9% in rural areas and from 9.3 to 16.6% in urban areas³. Uric acid is formed by the breakdown of purins and by direct synthesis from 5-phosphoribosyl pyrophosphate and glutamine. An elevated level of uric acid was found in pre-diabetic individuals, and in offspring of conjugal diabetic parents. However, conflicting results on uric acid concentrations have been reported in diabetic patients.⁷⁻⁹ Although some studies have demonstrated the role of Uric Acid in the progression of pre-diabetes to diabetes. Still, the role of Uric Acid in the pathogenesis and the development of the diabetic complications are controversial.^{10,11}

Neuropathy is common complication of diabetes mellitus leading to great morbidity.¹⁵ It is well known that neuropathy has a metabolic component in its pathophysiology^{17,18} Hence early metabolic aberrations as seen in Pre-Diabetics(IGT) may also lead to changes in the nerve conduction. Studies in the Caucasian population have shown that IGT is associated with dysfunction in peripheral nerves.^{19,20}

Present study was first time designed to look for the presence of neuropathy and it's association with serum uric acid in pre-diabetic and diabetic patients, in North Indian population. Emphasis was given on Pre-diabetics so that complications can be identified and managed in early stage.

II. MATERIAL AND METHOD

This is an observational study conducted in the department of physiology in collaboration with department of pathology at King George's Medical University, Lucknow. Total 79 subjects were enrolled in study based on well defined inclusion and exclusion criteria. Out of 79 subjects, 16 subjects were Pre-Diabetic and 63 subjects were Diabetic. Subjects with conditions, which may affect metabolic parameters (such as polycystic ovary syndrome or thyroid dysfunctions in history or present), pregnancy, chronic diseases, infection, and coronary artery disease, were excluded from study.

Definition

Pre-diabetic and diabetic patients were defined as per the American Diabetic Association (ADA) Guidelines 2010.

The subjects having impaired fasting blood glucose level 100-125mg/dl or 2 hours oral glucose tolerance test with 75 gm of glucose, 140-199 mg/dl were defined as Pre-diabetic patients.

Diabetic patients were defined as those having fasting blood glucose ≥ 126 mg/dl or 2 hours oral glucose tolerance test with 75 gm of glucose, ≥ 200 mg/dl.

Biochemical analysis

After ethical approval from institutional ethical committee of King George's Medical University, Lucknow and obtaining informed consent total 5 ml. venous blood sample was drawn from each participant. 2 ml. blood was collected in fluoride vial and 3 ml. blood was taken in plain vial. Serum and plasma was separated, aliquoted and stored at -80 C. Fasting blood sugar (FBS) and postprandial blood sugar (PPBS) estimation was done by glucose oxidaseperoxidase method (Merck Kit). Serum uric acid was estimated by using MERK Kit with the help of semi automated analyzer (Microlab 300, Merck) on the same day of sample collection.

Nerve Conduction Study

A detailed questionnaire was completed for each of the 79 participating subjects. Information was obtained, including age, gender, smoking history, history of alcohol consumption, duration of DM, history of hypertension or cardiovascular diseases, and symptoms related to peripheral neuropathy. NCV examinations was performed according to the standard method.

Diabetic Peripheral Polyneuropathy will be defined as a positive NCV and a positive neurologic physical exam in patients with a clinical MNSI score ≥ 3 and who also had accompanying neurologic symptoms such as paraesthesia, numbness, pain, and tingling sensation and there will be no apparent etiology of peripheral polyneuropathy besides diabetes.

The presence of polyneuropathy was documented by evaluating the latencies, amplitudes, and conduction velocities for motor nerves in both median, and peroneal nerves and for sensory nerves in both median and sural nerve.

The motor or mixed nerve is stimulated at least at two points along its course and Compound Muscle Action Potential (CMAP) is recorded. The surface recording electrodes are placed in belly tendon montage; keeping the active electrode close to the motor point and reference to the tendon. Ground electrode is placed between stimulating and recording electrodes. A biphasic action potential with initial negativity is thus recorded.

The measurements for motor nerve conduction study include the onset latency, duration, and amplitude of CMAP and nerve conduction velocity. **Onset Latency:** Time from the stimulus artifact to the first negative deflection of CMAP. Measure of conduction in the fastest conducting motor fibers. It also includes neuromuscular transmission time and the propagation time along the muscle membrane which constitute the residual latency. **Amplitude:** Measured from base line to the negative peak (base-to-peak) or between negative and positive peaks (peak-to-peak). The amplitude correlates with the number of nerve fibers. **Duration of CMAP:** Measured from the onset to the negative or positive peak or the final return of waveform to the base line. Duration correlates with the density of small fibers. Motor nerve conduction velocity is calculated by measuring the

distance in millimeter between two points of stimulation, which is divided by the latency difference in millisecond.

Principles of sensory nerve conduction:

The sensory conduction can be measured antidromically, in which nerve is stimulated at a proximal point and nerve action potential is recorded distally. The recommended filter setting for sensory conduction is 10 Hz to 2kHz, sweep speed 1-2 milisecond/division and gain 1-5 μ V/division.

III. STATISTICAL ANALYSIS

Continuous data were summarized as Mean \pm SD (standard deviation). Groups were compared by independent Student's t test and the results were also validated with non parametric Mann-Whitney U test. Discrete (categorical) observations were summarized in % and compared by chi-square (χ^2) test. Pearson correlation analysis was used to assess association between the variables. Diagnostic evaluation of S. uric acid was done by ROC (receiver operating characteristic) curve analysis. A two-sided ($\alpha=2$) $p < 0.05$ was considered statistically significant. SPSS (version 18.0) and STATISTICA (version 6.0) software were used for the analyses.

IV. RESULT

The age of Pre-diabetic and diabetic groups were ranged from 28-66 yrs and 32-77 yrs respectively with Mean \pm SD 49.50 \pm 11.57 yrs and 55.14 \pm 10.79 yrs, respectively. The mean age of Diabetic group was comparatively higher than Pre diabetic group. Further, in both the groups, the age (%) of males was higher than females. The mean level of both FBS and PPBS were comparatively higher in Diabetic group than Pre diabetic group. On comparing, the difference in mean age and % age of males and females were statistically not significant between the two groups. The mean Serum uric acid level of Diabetic group was significantly ($p < 0.001$) lower as compared to Pre diabetic group (**Table 1**) The diagnostic accuracy (cut off value) of S. uric acid levels for pre diabetics and diabetics were evaluated via ROC curve analysis. **Table 2 and figure 1.** The cut off value (criterion) of S. uric acid was ≤ 7 mg/dl and at this value it is discriminating diabetics with 77.78% sensitivity (95% CI=65.5-87.3) and 100.00% specificity (95% CI=79.2-100.0).

Nerve conduction velocity

It was observed that in 31(50%) diabetic patients sensory nerve conduction studies were non recordable. 50% diabetic patients showed sensory neuropathy While it was observed only in 12% prediabetics.

The mean level of Sensory-Left Median Latency was significantly ($p < 0.01$) higher in Diabetic group while Amplitude and Velocity lowered significantly ($p < 0.01$) as compared to Pre diabetic group.

Similarly, the mean level of Sensory-Right Median Latency was also significantly ($p < 0.01$) higher in Diabetic group while had significantly ($p < 0.01$) lower Velocity as compared to Pre diabetic group. However, Sensory-Right Median Amplitude did

not differed significantly ($p>0.05$) between the two groups i.e. found to be statistically the same.

In contrast, Left-Sural Latency, Amplitude and Velocity were almost similar ($p>0.05$) between the two groups.

Similarly, Right-Sural Latency, Amplitude and Velocity were also statistically not different between the two groups ($p>0.05$).

However, Motor-Right Median (wrist) Latency was significantly ($p<0.01$) higher in Diabetic group than Pre diabetic group while Amplitude and Velocity were similar ($p>0.05$).

The Motor-Left Median (wrist) Latency was also significantly ($p<0.01$) higher in Diabetic group than Pre diabetic group while Amplitude and Velocity not differed significantly ($p>0.05$) between the two groups.

The L-Common peroneal (ankle) Amplitude was significantly ($p<0.001$) lower in Diabetic group as compared to Pre diabetic group while Latency and Velocity were almost similar ($p>0.05$) between the two groups.

The R-Common peroneal (ankle) Amplitude and Velocity lowered significantly ($p<0.01$) in Diabetic group as compared to Pre diabetic group while latency was similar ($p>0.05$) between the two groups. (Table-3)

Correlation:

Table 4 showed that the S. uric acid of Pre diabetics negatively (inverse) and significantly correlated with neuropathy L-Sural Velocity ($r=-0.60$, $p<0.05$). However, other neuropathy parameters/variables did not ($p>0.05$) shows any association with Serum uric acid.

In contrast, Serum uric acid of Diabetics did not ($p>0.05$) shows any association with any of the neuropathy parameters/variables.

However, the S. uric acid of all (Pre diabetics + Diabetics) showed significant inverse association with Left-Sural Velocity ($r=-0.42$, $p>0.05$) while significant and direct association with Left-Sural Latency ($r=0.50$, $p<0.01$).

Table 1: Distribution of age, gender, FBS, PPBS and Serum Uric Acid inpre-diabetic and diabetic patients

Characteristics	Pre diabetic (n=16)	Diabetic (n=63)	p value
Age (yrs)	49.50 ± 11.57	55.14 ± 10.79	0.069
Gender: Male Female	11 (68.8%) 5 (31.3%)	49 (77.8%) 14 (22.2%)	0.451
FBS (mg/dl)	111.50 ± 10.56	142.66 ± 44.39	0.007*
PPBS (mg/dl)	168.75 ± 17.34	216.04 ± 52.89	0.001*
Serum uric acid (mg/dl)	10.84 ± 2.84	5.79 ± 1.87	$p<0.001^{**}$

*- $p<0.01$, values are in % (Categorical data) and mean±SD (Continuous data),
FBS (Fasting Blood Sugar), PPBS (Postprandial Blood Sugar)

Table 2: Diagnostic accuracy of S. uric acid level for diabetic from pre diabetic

Variables	Criterion (cut off value)	Sensitivity (95% CI)	Specificity (95% CI)	AUC	P value	+LR	-LR	+PV	-PV
S. uric acid	≤ 7 mg/dl	77.78 (65.5-87.)	100.0 (79.2-100.0)	0.947	$p<0.001$	-	0.22	100.0	53.3

+LR: Positive likelihood ratio; -LR- Negative likelihood ratio;+PV: Positive predictive value; -PV: Negative predictive value

Fig. 1: Diagnostic accuracy of Serum uric acid for pre diabetics and diabetics

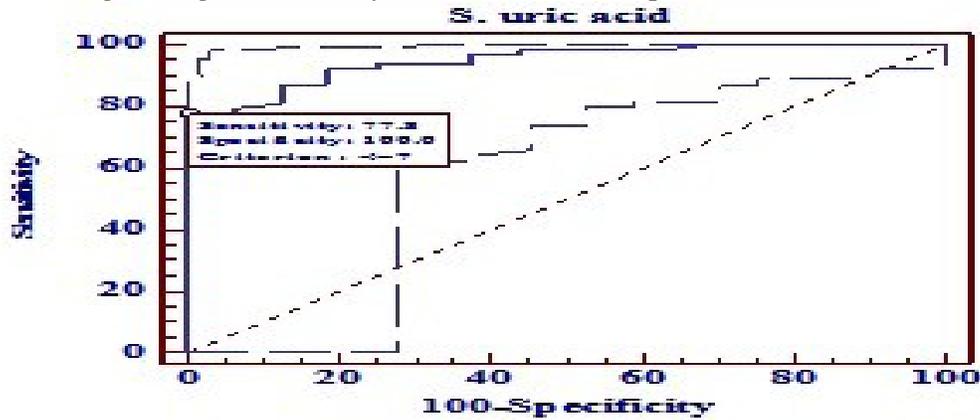


Table 3: Nerve conduction velocity parameters summary (Mean ± SD) of two groups

Parameters	Variables	N	Pre diabetic	N	Diabetic	t value	p value
S-L Median	Latency (ms)	16	2.43 ± 0.28	32	2.77 ± 0.40	3.05	0.004
	Ampl (µv)	16	43.17 ± 13.76	32	30.73 ± 12.29	3.18	0.003
	Velocity (m/s)	16	51.14 ± 7.05	32	45.58 ± 6.38	2.75	0.009
S-R Median	Latency (ms)	16	2.36 ± 0.30	33	2.78 ± 0.43	3.46	0.001
	Ampl (µv)	16	38.28 ± 16.98	33	31.80 ± 12.96	1.48	0.146
	Velocity (m/s)	16	53.38 ± 7.20	33	45.96 ± 7.06	3.43	0.001
Left -Sural	Latency (ms)	14	1.99 ± 0.29	30	1.82 ± 0.28	1.83	0.074
	Ampl (µv)	14	19.56 ± 5.18	30	22.60 ± 8.31	1.25	0.218
	Velocity (m/s)	14	50.05 ± 4.97	30	50.72 ± 7.56	0.30	0.763
Right-Sural	Latency (ms)	14	1.91 ± 0.27	32	1.90 ± 0.23	0.12	0.906
	Ampl (µv)	14	19.49 ± 5.82	32	24.98 ± 11.12	1.74	0.089
	Velocity (m/s)	14	51.19 ± 6.73	32	49.33 ± 5.64	0.97	0.337
M-R Median (wrist)	Latency (ms)	16	3.09 ± 0.32	61	3.78 ± 0.74	3.60	0.001
	Ampl (mv)	16	8.99 ± 3.62	61	7.70 ± 3.21	1.39	0.168
	Velocity (m/s)	16	53.76 ± 5.13	61	50.58 ± 6.16	1.90	0.062
M-L Median (wrist)	Latency (ms)	16	3.11 ± 0.49	58	3.88 ± 1.10	2.73	0.008
	Ampl (mv)	16	8.65 ± 4.16	58	8.81 ± 8.41	0.08	0.940
	Velocity (m/s)	16	54.08 ± 5.64	58	51.32 ± 7.07	1.44	0.155
Left-Common peroneal (ankle)	Latency (ms)	15	3.88 ± 0.94	38	7.34 ± 15.65	0.85	0.399
	Ampl (mv)	15	4.53 ± 1.60	38	2.63 ± 1.70	3.72	0.001
	Velocity (m/s)	15	48.53 ± 5.65	38	44.73 ± 6.44	2.00	0.051
Right-Common peroneal (ankle)	Latency (ms)	15	3.79 ± 0.48	40	7.48 ± 15.33	0.93	0.359
	Ampl (mv)	15	4.45 ± 1.82	40	2.91 ± 1.75	2.87	0.006
	Velocity (m/s)	15	50.06 ± 8.56	40	43.48 ± 7.86	2.70	0.009

*S-L Median-Sensory Left Median, S-R Median-Sensory Right Median, M-R Median- Motor Right Median, M-L- Median-Motor Left Median

Table 4 : Correlation of S. uric acid levels with neuropathy

Neuropathy parameters	Variables	Pre diabetic (n=14)	Diabetic (n=13)	Total (n=27)
		S. uric acid	S. uric acid	S. uric acid
S-L Median	Latency	-0.25	0.29	-0.22
	Amplitude	0.04	-0.17	0.24
	Velocity	0.06	0.05	0.25
S-R Median	Latency	0.27	-0.21	-0.15
	Amplitude	0.14	-0.26	0.25
	Velocity	-0.21	0.35	0.26
Left-Sural	Latency	0.21	0.44	0.50**
	Amplitude	0.09	-0.09	0.00
	Velocity	-0.61*	-0.32	-0.42*
Right-Sural	Latency	-0.21	0.22	0.06
	Amplitude	0.20	-0.17	-0.21
	Velocity	-0.33	0.15	0.07
M-R Median (wrist)	Latency	0.09	-0.05	0.01
	Amplitude	-0.03	-0.06	-0.03
	Velocity	-0.48	0.13	0.07
M-L Median (wrist)	Latency	0.09	0.35	0.06
	Amplitude	0.13	-0.24	-0.04
	Velocity	-0.05	-0.23	-0.22
Left-Common peroneal (ankle)	Latency	0.07	0.46	0.03
	Amplitude	0.45	-0.36	0.32
	Velocity	0.29	-0.04	0.28
Right-Common peroneal (ankle)	Latency	-0.07	0.09	-0.05
	Amplitude	0.42	0.11	0.33
	Velocity	0.22	-0.01	0.33

*S-L Median-Sensory Left Median, S-R Median-Sensory Right Median,
M-R Median- Motor Right Median, M-L- Median-Motor Left Median

V. DISCUSSION

In our study S. uric acid level of diabetic group was significantly lower than prediabetic (p<0.001). These findings were consistent with the previous study, demonstrated that diabetics have lower serum uric acid levels and that prediabetics have higher levels than non-diabetics.^{7,29-33} The reduced urate level in severe hyperglycemia has been attributed to the uricosuric effect of glycosuria, which might be an explanation of the low uric acid concentration among overt diabetic patients.³⁴ Furthermore, uric acid concentration might be influenced by the changes in plasma glucose and insulin concentrations.³⁵ Thus, uric acid fluctuations during prediabetes and diabetes have so far been regarded as a secondary metabolic phenomenon. In other previous study it was also reported that serum uric acid has been shown to be associated with oxidative stress and production of tumor necrosis α , both of which are related to development of diabetes.³⁶ Elevated serum uric acid levels may reflect prediabetes status particularly at the renal level. Higher insulin level associated with prediabetes can reduce renal excretion of uric acid.³⁷ Insulin can stimulate urate anion exchanger and it increases renal urate reabsorption³⁸. The cut off value of Serum uric acid in our study was ≤ 7 mg/dl and at this value it is discriminating diabetics with 77.78% sensitivity and 100.00% specificity. Result of the study supports the previous report based

on 475 overweight or obese individual with impaired glucose tolerance, they found that having a serum uric acid level within the top tertile (≥ 6.4 mg/dl) was associated with two-fold increase in the risk of type-2 diabetes compared with the lower tertile (< 5.2 mg/dl)³⁹. Although it was multifactorial cause but as per our study findings, it may be concluded that high Serum uric acid in prediabetics can be considered as a predictor of diabetes .

Neuropathy is most common complication of diabetes mellitus¹³. As Pre-Diabetes (IGT) is a forerunner of diabetes and prevalence of nerve conduction abnormalities in the IGT stage calls for early screening of these subjects for complications. Nerve conduction studies (NCS) are gold standard and the most consistent indicator of nerve damage even in subclinical (largely asymptomatic) neuropathy.

The early detection of abnormal glucose metabolism is particularly important, as treatments will probably be most effective if administered early in the course of neuropathy, when abnormalities of peripheral nerves are more likely to be reversible.

In our study mean level of Sensory Right and Left Median Latency were significantly (p<0.01) higher in Diabetic group as compared to Pre diabetic group, but velocity of the same nerves were significantly (p<0.01) lower in Diabetic group as compared to Pre diabetic group.

Motor Right and Left Median nerve latency were significantly (p<0.01) higher in Diabetic group as compared to Pre diabetic group but velocity decreases in Diabetic group as

compared to Pre diabetic group, but statistically not significant ($p>0.05$).

Right and Left Common peroneal Amplitude and velocity were significantly ($p<0.001$) lower in Diabetic group as compared to Pre diabetic group but latency increases in Diabetic group as compared to Pre diabetic group, but not statistically significant ($p>0.05$). No significant changes were observed in sural nerve on both side.

The major finding of the our study was that the prediabetic subjects exhibited minimal changes in nerve conduction abnormalities in comparison to diabetic subject. Result of our study shows decreased sensory conduction velocity in both median and right sural nerve. Motor conduction velocity in median and common peroneal (both side) were decreased in diabetic subject in comparison to prediabetic subjects. Thrainsdottir et al,⁴⁰ had shown that increased basal membrane thickening was associated with sensory peripheral neuropathy in IGT and diabetic subjects. This may be one of the reasons for slower MCVs in the IGT subjects in this study.

In our study serum uric acid of Pre diabetics negatively (inverse) and significantly correlated with neuropathy L-Sural Velocity ($r=-0.60$, $p<0.05$). However, other neuropathy parameters/variables did not ($p>0.05$) shows any association with S. uric acid levels. S. uric acid of Diabetics did not ($p>0.05$) shows any association with any of the neuropathy parameters/variables.

VI. CONCLUSION

It has been documented that neuropathy often is subclinical, therefore, if such a patient does not show signs of neuropathy on the clinical neurological assessment, referral for a nerve conduction studies may be ancillary tools to detect incipient neuropathy. As per our study findings in diabetics nerve conduction velocity was lowered as compared to prediabetics. Though the neuropathy was more common in diabetics but it also affect the prediabetics. It is important to evaluate the patients in prediabetic stage so that prevention and early intervention can be possible. This can be possible by evaluation of serum uric acid level in prediabetics. As per our study uric acid level might be useful for prediction of diabetes.

Disclosure of Interest: None

REFERENCES

- [1] Brownlee M, Cerami A. Biochemistry of the complications of diabetes mellitus. *Annu rev. Biochem* 1981; 50: 385-432.
- [2] Thomas F. Luscher, Mark A. Creager, Joshua A. Beckman and Francesco Cosentino. Diabetes and vascular disease: Pathophysiology , Clinical consequences and medical therapy: Part II . *Circulation*. 2003; 108 (13): 1655-1661.
- [3] K Park et al. Diabetes mellitus. In. park`s text book of preventive and the social medicine, 20 ed. Jabalpur, M/s Banarasidas Bhanos publication, 2009, p. 341-345.
- [4] Robert I. Wortmann et al. Disorders of purine and pyrimidine metabolism. In. Harrison`s principle of internal medicine, 18th ed. Longo Dan L et al(eds). New York, Mc Graw Hill; 2012. p. 3181-3185.
- [5] Victor w Rodwell et al. Metabolism nucleotides. In. Harper`s illustrated biochemistry, 28th ed . Robert murray et al (eds.). New York, Mc Graw Hill, Lange publishers; 2009. p. 287-289.

- [6] Waring WS, Mcknight JA, Webb DJ, and Maxwell SR. Uric Acid Restores Endothelial Function in Patients with Type 1 Diabetes and Regular Smokers. *Diabetes* 2006; 55 (11): 3127-3132.
- [7] Herman JB, Goldbourt U. Uric acid and diabetes: observations in a population study. *Lancet* 1982; 320: 240-243.
- [8] Mohan V, Snehalatha C, Jayashree R, Ramachandran A, Viswanathan M, Kameswaran L, et. al. Serum uric acid concentrations in offspring of conjugal diabetic patients (parents). *Metabolism: Clinical and Experimental* 1984; 33 (9): 869-871.
- [9] Yano K, Rhoads GG, Kagan A. Epidemiology of serum uric acid among 8000 Japanese-American men in Hawaii. *J Chron Dis* 1977; 30:171-184.
- [10] Dehghan A, van Hoek M, Sijbrands EJ, Hofman A, Witteman JC. High levels of serum uric acid as a novel risk factor for type 2 diabetes mellitus. *Diabetes Care* 2008; 31 (2): 361-362.
- [11] Hayden MR, Tyagi SC. Uric acid: A new look at an old risk marker for cardiovascular disease, metabolic syndrome, and type 2 diabetes mellitus: The urate redox shuttle. *Nutr and Metab (Lond)*.2004;1:10.
- [12] Modan M, Halkin H, Almog S, Lusky A, Eshkol A, Shefi M, et. al. Hyperinsulinemia. a link between hypertension, obesity and glucose intolerance. *J Clin Invest* 1985; 75 (3) : 809-817.
- [13] Ford ES: Body mass index, diabetes, and C-reactive protein among US adults. *Diabetes Care* 1999;22:1971-1977.
- [14] Temelkova-Kurktschiev T, Henkel E, Koehler C, Karrei K et al. Subclinical inflammation in newly detected type II diabetes and impaired glucose tolerance. *Diabetologia* 2002;45:151.
- [15] McCarty D, Zimmet P. Diabetes 1994 to 2010, Global Estimates and Projections. Melbourne: International Diabetes Institute; 1994.
- [16] Vinik AI, Mitchell BD, Leichter SB, Wagner AL, O'Brian JT, Georges LP. Epidemiology of the Complications of Diabetes. In: Leslie RDG, Robbins DC, editors. *Diabetes: Clinical Science in Practice*. Cambridge: Cambridge University Press; 1995. p. 221-87.
- [17] Sugimoto K, Nishizawa Y, Horiuchi S, Yagihashi S. Localization in human diabetic peripheral nerve of N-carboxymethyllysine-protein adducts, an advanced glycation end product. *Diabetologia* 1997;40:1380-7.
- [18] Veves A, Akbari CM, Primavera J, Donaghue VM, Zacharoulis D, Chrzan JS, et al. Endothelial dysfunction and the expression of endothelial nitric oxide synthetase in diabetic neuropathy, vascular disease, and foot ulceration. *Diabetes*. 1998;47:457-63.
- [19] Singleton JR, Smith AG, Bromberg MB. Painful sensory polyneuropathy associated with impaired glucose tolerance. *Muscle Nerve* 2001;24:1109-12.
- [20] Sumner CJ, Sheth S, Griffin JW, Cornblath DR, Polydefkis M. The spectrum of neuropathy in diabetes and impaired glucose tolerance. *Neurology*. 2003;60:108-11.
- [21] Carrington AL, Shaw JE, Van Schie CH, Abott CA, Vileikyte L, Boulton AJ. Can motor nerve conduction velocity predict foot problems in diabetic subjects over a 6 year outcome period? *Diabetes Care*. 2002;25:2010-2015.
- [22] Vinik AI, Park TS, Stansberry KB, Pittenger GL. Diabetic neuropathies. *Diabetologia*. 2000;43:957-973.
- [23] Kim BW, Kim DH, Kim JG. Comparisons between several neurologic tests of large myelinated nerves in type 2 diabetic patients with peripheral polyneuropathy. *J Korean Diabetes Assoc*. 1999;23:562-574.
- [24] Feldman EL, Stevens MJ, Thomas PK, Brown MB, Canal N, Greene DA. A practical two-step quantitative clinical and electrophysiological assessment for the diagnosis and staging of diabetic neuropathy. *Diabetes Care*. 1994;17:1281-1289.
- [25] Van Deursen RW, Sanchez MM, Derr JA, Becker MB, Ulbrecht JS, Cavanagh PR. Vibration perception threshold testing in patients with diabetic neuropathy: Ceiling effects and reliability. *Diabet Med*. 2001;18:469-475.
- [26] Muller MJ. Identifying patients with diabetes mellitus who are at risk for lower-extremity complications: use of Semmes-Weinstein monofilaments. *Phys Ther*. 1996;76:68-71.
- [27] Ferreira MC, Rodrigues L, Fels K. New method for evaluation of cutaneous sensibility in diabetic feet: preliminary report. *Rev Hosp Clin Fac Med Sao Paulo*. 2004;59:286-290.
- [28] Tkac I, Bril V. Glycemic control is related to the electrophysiologic severity of diabetic peripheral sensorimotor polyneuropathy. *Diabetes Care* 1998;21:1749-52.

- [29] Krishnan E, Pandya B J, Chung L, Hariri A and Dabbous O. Hyperuricemia in young adults and risk of insulin resistance, prediabetes and diabetes: A 15 year follow up study. *Am J Epidemiol.*2012; 176 (2): 108-116.
- [30] Sudhindra RM, Sahayo BJ. A study of serum uric acid in diabetes mellitus and prediabetes in a south Indian Tertiary care hospital. *NUJHS.* 2012; 2 (2): 18-23.
- [31] Chien KL, Chen MF, Hsu HC, Chang WT, Su TC, Lee YT, et. al. Plasma uric acid and the risk of type2 diabetes in a Chinese community. *Clin. Chem.*2008; 54 (2): 310-316.
- [32] Feig DI, Mazzali M, Kang DH, Nakagawa T, Price K, Kannelis J, et. al. Serum uric acid: a risk factor and a target for treatment, *J. Am. Soc. Nephrol* 2006; 17 (2) : 69-73.
- [33] Dawber TR, Meadors GF, Moore FE Jr. Epidemiological approaches to heart disease: the Framingham Study. *Am J Public Health Nations Health*1962; 195; 4 (3): 279-281.
- [34] Gotfredsen A, McNair P, Christiansen C, Transbol I. Renal hypouricaemia in insulin treated diabetes mellitus. *Clin Chim Acta* 1982; 20: 355-361.
- [35] Modan M, Halkin H, Karasik A, Lusky A. Elevated serum uric acid - a facet of hyperinsulinemia. *Diabetologia* 1987; 30: 713-718.
- [36] Koenig W, Meisinger C. Uric acid, type 2 diabetes, and cardiovascular diseases: fueling the common soil hypothesis? *Clinical Medicine* 2008; 54 (12): 231-233.
- [37] Muscelli E, Natali A, Bianchi S, Bigazzi R, Galvan AQ, Sironi AM, et.al. Effects of insulin on renal sodium and uric acid handling in essential hypertension. *Am J Hypertens.* 1996; 9 (8): 746-752.
- [38] Enomoto A, Kimura H, Chairoungdua A, Shigeta Y, Jutabha P, Ho Cha S, et.al. Molecular identification of a renal urate anion exchanger that regulates blood urate levels. *Nature.* 2002; 417: 447-452.
- [39] Niskanen L, Laaksonen DE, Lindstrom J, Eriksson JG, Keinanen-Kiukaanniemi S, Ilanne-Parikka P, et al. Serum uric acid as a harbinger of metabolic outcome in subjects with impaired glucose tolerance: the Finnish Diabetes Prevention Study. *Diabetes Care* 2006; 29 (3): 709-711.
- [40] Thainsdottir S, Malik RA, Dahlin LB, Wiksell P, Eriksson KF, et al. Endoneurial capillary abnormalities presage deterioration of glucose tolerance and accompany peripheral neuropathy in man. *Diabetes* 2003;52:2615-22.
- [41] Graf RJ, Ilalter JB, Pfeifer MA, Ilalar E, Brozovieh F, Porte D Jr. Glycemic control and nerve conduction abnormalities in non-insulin dependent diabetic subjects. *Ann Intern Med* 1981;94:307-311.

AUTHORS

First Author – Radhey Shyam, Department of Geriatric Mental Health, King George’s Medical University, Uttar Pradesh, Lucknow, India

Second Author – Pushalata Sachan, Department of Physiology, King George’s Medical University, Uttar Pradesh, Lucknow, India

Third Author – Munna Lal Patel, Department of Medicine, King George’s Medical University, Uttar Pradesh, Lucknow, India

Fourth Author – Shradha Singh, Department of Physiology, King George’s Medical University, Uttar Pradesh, Lucknow, India

Fifth Author – Sunita Tiwari, Department of Physiology, King George’s Medical University, Uttar Pradesh, Lucknow, India

Correspondence Author – Dr. Radhey Shyam, Department of Geriatric Mental Health, King George’s Medical University, Uttar Pradesh, Lucknow, India, E-mail: raddy.kgmc@gmail.com

A Review of Agricultural Commodity Financialisation in India

Riju koruth and J. Mohamed Zeyavudheen

Department of Economics, Jamal Mohamed College, Bharathidasan University, Tiruchirappalli - 620 020

Abstract- In an agriculture based economy like India, farmers face several risks in the agricultural process such as rise in prices and low yield. The present study is an attempt to overview agriculture commodity financialisation in India by taking into account, various results and findings of studies on agriculture commodity financialisation. This study has been classified into three sections i.e. growth and performance of the derivative commodity market, agriculture commodity financialisation and price movements in India and relationship between spot market prices and future prices. The paper brings out the growth in agricultural commodity financialisation in India and how the agricultural commodity financialisation influences the price movements and also shows a relationship between future prices and spot market prices.

Index Terms- Agricultural commodity financialisation, derivative market, Spot Market, Price Discovery, Risk Management.

I. INTRODUCTION

Commodity markets touch the lives of all citizens of the country, either as producers or as consumers (FMC Annual Report, 2012-13). It is an important constituent of the financial markets of any country. Commodity means all kinds of movable property other than actionable claims, money and securities. It is the market where a wide range of products, viz. precious metals, base metals, crude oil, energy and agricultural commodities, etc. are traded (<http://www.slideshare.net>). India being an agriculture based economy has a surplus agriculture production. During the year 2012-13 the value of agricultural commodity trading was ₹21.56 lakhs crores whereas agricultural commodities contribute 13 per cent to the total trade of the commodities (Harwinder Pal Kaur and Dr. Bimal Anjum feb.2014). It is important to develop a vibrant and liquid commodity market. This would help investors hedge their commodity risk, take speculative positions in commodities and exploit arbitrage opportunities in the market (<http://www.slideshare.net>).

With the increasing volatility of the market, investors are interested in diversified investment avenue that reduce the risk of investment. Derivative or financialisation is used as a tool for managing risk in the market. Greta Krippner of the University of Michigan has written that financialisation refers to a "pattern of accumulation in which profit making occurs increasingly through financial channels rather than through trade and commodity production." (<http://en.wikipedia.org/wiki/Financialization>). A commodity futures market can be defined as a place where buyers and sellers of the commodities enter into an agreement

(contract) to exchange the commodity at predetermined price for delivery on a future date. Commodity futures perform two economic functions that is Price discovery¹ and Price risk management² (Harwinder Pal Kaur and Dr. Bimal Anjum 2014).

Structure of derivative market in India

Commodity financialisation is a risk management tool that existed in India for more than a century. Commodity financialisation or Commodity derivative market is organised in such commodities as are permissible by the government. Since April 2003, commodity financialisation or future trading was permitted in all commodities by government of India. There is a three tier regulatory structure of future trading in India-Government of India, Forward market commission and commodity exchanges and also a two tier structure for commodity exchanges-regional and country wide exchanges. (Harwinder Pal Kaur and Dr. Bimal Anjum 2013). At present, 113 commodities are traded in Indian commodity future market on 6 national commodity exchanges and 13 commodity specific exchanges. (Harwinder Pal Kaur and Dr. Bimal Anjum feb.2014). The total number of commodities traded on Futures Exchanges are categorized into two major groups, viz., Agricultural Commodities and Non-Agricultural Commodities. In 2010-11, bullions occupied the first position with 45 per cent share followed by metals with 24 per cent and energy with 19 per cent. The share of agricultural commodities in futures trading has come down to the level of 12 per cent. This paper is an attempt to review the literature and key findings on agricultural commodity futures in India. This paper is divided in to three different sections. Section 1 includes introductory part i.e. meaning, definition and structure of commodity financialisation, In Section 2, growth and performance of commodity futures market in India has been discussed. Section 3 explains the literature on Agricultural commodity financialisation and price movements in India. While Section 4, describes the relationship between spot market price and future prices in India and Section 5, concludes the paper by identifying problems of agricultural commodity futures.

¹ **Price discovery** refers to the act of determining the proper price of a security, commodity, or good or service by studying market supply and demand and other factors associated with transactions. Price discovery has been defined as revealing information about future cash market prices (spot market) through the futures market. There is a relationship between the futures price of a commodity and the price that market participants expect to prevail at the time of delivery of the futures contract. Hence, futures prices help market participants make better estimates of future prices, so that they can make their consumption and investment decisions more optimally

² **Risk management** is the process of identifying the desired level of risk, identifying the actual level of risk and altering the latter to equal the former. This process can fall into the categories of hedging and speculation.

II. GROWTH AND PERFORMANCE OF DERIVATIVE COMMODITY MARKET

Gaurav Raizada & Gurpreet Singh Sahi (2006) pointed out that in 2002-03, the government of India took two steps that gave a fillip to the commodity markets i.e. setting up of nationwide demutualised multi commodity exchanges and expansion of list of commodities permitted for trading. In May 2006 the commodity futures markets have average daily volumes of more than ₹4000 crores. The total volume of commodity futures trading in the country has reached ₹190000 crores during the first quarter of the 2006-07, showing a significant growth of 800 per cent as per the statistics by FMC.

Gopal Naik, Sudhirkumar Jain (2002), explained that the performance of Indian commodity futures market varies on commodities, exchanges and contracts. However it reveals the potential for performing the functions of price discovery and risk management.

Rajnarayan Gupta (2011) indicated that the total value of trade in the Commodity Futures Market has risen substantially in the last few years. Total value of trading in the commodity futures market rose from ₹34, 84,485 crore in 2006 to ₹94, 94,725 crore in 2010, i.e. nearly 367 per cent. The growth could be attributed to larger participation in the market, increase in global commodity prices, the advent of new commodity exchanges and the restoration of trade in some of the suspended agricultural commodities.

Harwinder Pal Kaur and Dr. Bimal Anjum (2013) pointed out that Indian economy has witnessed mini resolution in commodity Future market since 2003 as a result of the revival of commodity futures in a big way. Commodity futures perform two vital functions of the economy that is Price discovery and Risk management. Advance price signals help the farmers and traders of the agricultural commodities to grab superior price to earn more profit and price risk management enables the farmers to avoid price fluctuations. It provides liquidity to the participants and trading can be done in multi commodities at a single point of time.

Narender.L.ahuja (2006) reported that Since 2002, the commodities futures market in India has experienced an unprecedented boom in terms of the number of modern exchanges, number of commodities allowed for derivatives trading as well as the value of futures trading in commodities, which might cross the \$ 1 Trillion mark in 2006. While in year 2000, futures trading was allowed in only 8 commodities, the number jumped to 80 commodities in June 2004. The value of trading in local currency saw a quantum jump from about ₹350 billion in 2001-02 to ₹1.3 Trillion in 2003-04.

Dr. Kedarnath Mukherjee (2011) studied that the cumulative value of commodity trading in India during April to December 2010, as reported by FMC, is ₹82.71 lakh crore with a growth of 49.66 per cent from the same period in the last year. Even if the growth in all commodities is quite significant, the growth in agricultural commodities in India for the same period is found to be only 7.48 percent.

Meenakshi Malhotra (2012) studied that the volume of commodity futures trading in India has increased from ₹20.53 trillion in 2006 to ₹181.26 trillion in 2011-12 i.e. a growth of nearly 883 per cent. In spite of fast growth, the commodity

markets have gone through tumultuous times especially after independence.

III. AGRICULTURAL COMMODITY FINANCIALISATION AND PRICE MOVEMENTS

Dr. Kedarnath Mukherjee (2011) made an attempt to revalidate the impact of futures trading on agricultural commodity market in India. He has used the daily price information in spot and futures markets, for a period of 7 years (2004 – 2010), for 9 major agricultural commodities (Spices, Pulses, Cereals, Oil and Oil Seeds, and Others) was extracted from NCDEX data base and are incorporated into various econometric models, such as Multiple Regression, Vector Auto Regression, Granger Causality Test, GARCH model to test the concerned objective. His study exhibited the inflationary pressure on commodities, especially agricultural commodities, i.e. prices have gone up sharply after the introduction of commodity futures contracts and it led to spot market volatility.

Ms. Shalini H.S & Dr. R. Duraipandian (2014) studied that the price discovery mechanism is quite effective for most commodities but may not be very effective for some commodities. The sample used in the study consists of nine agricultural commodities which are actively traded on NCDEX in the study period of 1st April 2012 to 31st March 2013, selected according to the availability of data. In particular, causality in commodities markets can be used to either hedge or speculate price movements: if changes in spot prices drive changes in futures prices, efficient hedging strategies can be formulated; whereas if changes in futures prices drive changes in spot prices, efficient speculation strategies can be formulated. Further, causality can be used in forecasting commodity spot and futures prices.

Madan Sabnavis & Shilpa Jain (2007) provided clarification with both facts and global parallels. The study reveals that price volatility for a comparable period (Annual Average Price Volatility of 2001-04 and 2004-06) before and after futures trading³ shows that price volatility has actually decreased after futures trading. Annual volatility has been defined as the standard deviation of the daily percentage changes in prices. Higher prices in the cash markets have been caused by economic fundamentals like supply shortages and there is evidence to show that price volatility has come down in the post futures trading era (after 2003). Futures prices have been defined as spot prices plus cost of carry. Futures prices also reflect the expectations of production and hence, supply flows. Spot prices depend upon actual demand-supply balances in the country and hence, are quite divorced from the futures markets. Econometric analyses of these relationships have been inconclusive but there is evidence to show that higher spot prices have been associated with supply shortages in the last two years or so (before 2007).

Tulsi Lingareddy (2008) indicated that the futures trading in India, in the modern exchanges era, has led to an increase in volatilities in majority of the largely traded commodities during the period of excess liquidity. Further, a uni-directional increase

³ In 2003, with the announcement of New Agricultural Policy ban from commodity trading has been removed and trading was permitted in all the commodities. After 2003 is the post future trading era.

in prices was also observed in the cases of commodities with small market size and scarce deliverable supplies in the market. The price analysis using both monthly and weekly wholesale price index data was carried out for 21 commodities. Under scarce supply situations, futures trading may bud an increase in prices as everyone expects prices to rise.

Gaurav Raizada & Gurpreet Singh Sahi (2006) studied the commodity futures market efficiency in India and only 3 month wheat futures at NCDEX have been included in this study. Daily spot market rate and futures prices from Jan 2004 to July 2006 provided by NCDEX online database have been used for this study. The study stressed that the commodity futures markets is not efficient even in the short-run. The social loss⁴ statistic also indicates poor price discovery. The growth in commodity futures markets volumes also has a significant impact on the inflation in the economy.

Himadri bhattacharya (2007) traces the evolution and development of the commodity derivatives market in India. It pointed that the rising prices of farm goods or essential commodities is politically sensitive. Worse, there is no guarantee that the benefit of high prices will go to the primary producer or grower to any significant extent. Indeed, most farmers continue to get the minimum support price or thereabouts as they do not have facilities to warehouse the produce and sell as and when they want to. By allowing more money to flow into the commodity market, there is the danger of rising prices without corresponding benefits flowing back to those in the farm sector. Intermediaries -traders, speculators- make money. Under Indian conditions, supply response to prices is limited.

Golaka C Nath & Thulasamma Lingareddy (2008) studied the impact of futures trading in three important commodities which were banned by the government from trading in futures and their impact on spot prices. The study covers three important commodities: *urad, gram and wheat* and the Wholesale Price Index (WPI) series, compiled and published by the Central Statistical Organisation (CSO), were taken. This study cover a period from January 2001 to August 2007. Apart from prices, commodity-wise futures volumes were collected from the websites of the respective exchanges and the forward Markets Commission (FMC). Linear regression analysis was carried out to test the statistical significance of the apparent impact of futures trading on spot prices of urad, wheat and gram. They analysed that futures were increased volatilities in the spot market for some of the commodities. The price volatility increased significantly during the period when futures were allowed and fall in volatility after the ban of futures.

IV. SPOT MARKET PRICE AND FUTURE PRICE

Ms. Shalini H.S & Dr. R. Duraipandian (2014) found that the commodities that showed contango⁵ to a marked extent, with average spot prices significantly lower than average futures

⁴ Social loss is the social cost imposed by a monopoly. In other words, it is the net economic burden that a monopoly imposes on the public.(Due to a lack of competition, a monopoly increases its profits by reducing its output and raising the price).

⁵ Contango means the situation in a futures market where prices for future delivery are higher than prices for immediate (or nearer) delivery.

prices, were as follows: Chana (57.83%), rubber (90.67%), soya bean oil (57.73%), but the difference in their average spot prices and their average futures prices was not statistically significant. On the other hand, the commodities that showed significant backwardation⁶, with average futures prices significantly lower than average spot prices, were as follows:- jute (57.33%), mentha oil (91.63%). It was found that some commodities, viz. crude palm oil, wheat, potato, cardamom showed mixed tendencies of contango and backwardation, with no significant difference in average spot prices and average futures prices.

Harwinder Pal Kaur & Dr. Bimal Anjum (2014) made an attempt to differentiate between commodity futures and spot prices of wheat by analysing the relationship between both the prices. The period of study was from January 2006 to December 2011. The result had shown that the significant correlation between both of the prices of Wheat and the reason behind the similarity is the demand for wheat. Wheat being a major crop is in demand throughout the year by the farmers, consumers, traders and processors for different purposes. It implies that there is a linear relationship between spot and future prices of wheat in India. An increase in the spot prices of the selected commodities resulted into corresponding increase in the futures prices of the selected commodity and on the other hand a negative trend in the commodity futures market has resulted into a decreasing trend in the prices in the commodity futures market. The reason behind this behaviour is the dependence of futures market on the spot market has been found. Futures market basically depends on spot market for the determination of price. Spot prices have the impact on the commodity futures markets.

Himadri Bhattacharya stressed that the derivative market cannot exist without an underline spot market. Hence, what is needed most is a vibrant physical market on which a dynamic and transparent futures market can be built. Future price is at a premium to the spot price, representing the cost of carry while the far futures are at discount to the spot price and there is high correlation between futures and spot prices.

Dr.kedarnath mukerjee found the interdependence between the spot and future market in agricultural commodity sector in Indian commodity market. He used the daily price information in spot and futures markets, for a period of 7 years (2004 – 2010), for 9 major agricultural commodities, taken from different categories of Agricultural products, are incorporated into various econometric models to test the concerned objective. He studied that there is strong bi-directional interdependence between the spot and futures market in terms of returns and, the volatility interdependence, irrespective of the significant contemporaneous relation, is almost unidirectional from spot to futures market.

Nandini H.D and Dr.mahadevappa studied Price Discovery Dynamics of Wheat in Indian Futures and Spot Market. The study considers futures and spot price of wheat. A sample of twenty six months data i.e. from Jan 2005 to Feb 2007 is taken for the study. The data collected from Multi Commodity Exchange (MCX). Regression and Correlation Analysis has been used to analyse the relationship and influencing factor between futures and Spot prices of wheat. It shows that there is high

⁶ Backwardation means that the situation in a futures market where prices for future delivery are lower than prices for immediate (or nearer) delivery. Generally arising from a near term shortage of a commodity.

significant correlation between futures and spot market and both influence each other.

V. CONCLUSION

Commodity financialisation has been growing at a very high pace in India. Derivatives provide hedging opportunities and also help in price discovery. But there are a lot of problems in developing countries like India because of the deficiencies in infrastructure, management, linkages with financial institutions, dominance of speculators and efficient information system which discourage market players. The argument of price discovery, hedging of price risk, risk sharing etc. as the important functions of derivative market, there is possibility of price rise in spot market and inflation, leading to spot market volatility and it shows that there is significant relationship between the spot and futures prices. By allowing more money to flow into the commodity market, there is the danger of rising prices without corresponding benefits flowing back to those in the farm sector. The studies shows that the growing commodity financialisation make spot market volatility and also causes to inflation so commodity market in India need government intervention in every aspects.

REFERENCES

- [1] Bhattacharya, Himdari, "Commodity Derivatives Market in India", Economic and Political weekly, Money Banking and Finance Vol. 42 No. 13, 2007, pp. 1151-1162.
- [2] Mukherjee, Kedarnath, "Impact of futures trading on Indian Agricultural Commodity Markets" MPRA Munich Personal RePEc Archive, 2011, paper no.29290.
- [3] Naik, Gopal and Jain Sudhir Kumar, "Indian Agricultural Commodity Futures Market: A Performance Survey", Economic and Political weekly, Vol. 37, No. 30, 2002, pp 3167-3173.
- [4] Sahi, Gurpreet Singh and Raizada, Gaurav, "Commodity Futures Market Efficiency in India and Effect on Inflation", electronic copy available on <http://ssrn.com/abstract=949161>, 2006 (accessed 30 September 2012).
- [5] Nath, G.C, and Lingareddy, T, "Commodity Derivative Market and its Impact on Spot Market", SSRN Working Paper Series, <http://ssrn.com/abstract=1087904>, 2008.
- [6] Kaur, Pal, Harwinder and Anjum, Bimal, "Agricultural Commodity Futures in India – A Literature Review", Galaxy International Interdisciplinary Research Journal, Vol. 1(1), 2013.
- [7] H.S, Shalini* and Pandian, Durain, R, "Commodity Derivative Markets in India: Issues and Concerns", International Journal of Management, IT and Engineering, Vol. 4, Issue 2, 2014.
- [8] Kaur, Pal, Harwinder and Anjum, Bimal, "Relationship between Commodity futures and Spot Prices of Wheat in India", Zenith International Journal of Multidisciplinary Research, Vol. 4(2), 2014.
- [9] Sabnavis, Madan and Jain, shilpa "Working of Commodity Futures Markets", Economic and Political Weekly, Vol.42, No. 18, 2007, PP.1641-1643.
- [10] Lingareddy, Tulsi, "Expert Commity on Commodity Futures: Agreements and Disagreements", Economic and Political Weekly, Vol. 43, No. 34, 2008, PP.35-42.
- [11] Nandini, H.D* and Mahadevappa, B, "Price discovery dynamics of wheat in Indian futures and spot market", Asian journal of research in business, economics and management, vol.4, no.12, 2014, pp.01-08.
- [12] Gupta, Rajnarayan, "Commodity Derivative Market in India: The Past, Present and Future", Analytique, Vol .VII.No.2, 2011.
- [13] Forward markets commission, government of India, ministry of consumer affairs, food and public distribution department of consumer affairs, annual report 2012-13.
- [14] Narender.L Ahuja, "Commodity derivatives market in India; development, regulation and future prospects", International journal of finance and economics, ISSN 1450-2887, issue2, 2006.
- [15] Velmurugan.P.shanmugam, Bill Hu, & Cheng-huei chiao" Agricultural commodity price spikes since 2006: A new look at the efficiency of US futures markets", International conference on banking and finance, 2012. <http://www.slideshare.net/manishnandal1/commodity-derivatives-market>, 2012.
- [16] Malhotra Meenakshi, "Price discovery and impact on spot price volatility: Anecdotes from Indian commodity futures market", Anveshanam- A national journal of management, vol.1, no.1, 2013.

AUTHORS

First Author – Dr. J. Mohamed Zeyavudheen, Email id. riju.koruth123@gmail.com, Mobile no. 09497360916
Second Author – Riju koruth, Research scholar, Department of Economics, Jamal Mohamed College, Bharathidasan University, Tiruchirappalli-620020, Emali id: zeyajmc@yahoo.co.in

Solitary Rectal Ulcer Syndrome - The Masquerader

Odaiyappan Kannappan, Stanley Mathew, Ravikiran Naalla

Department of General Surgery, Kasturba Medical College, Manipal, Manipal University

Abstract- Introduction: Solitary rectal ulcer syndrome (SRUS) is a great masquerader and misdiagnosis has serious implications for the patient. **Methods and materials:** We reviewed 21 patients with histopathologically proven SRUS at our tertiary care teaching hospital in South India. **Results:** Bleeding per rectum and constipation with passage of mucous were the common symptoms at presentation. Endoscopy revealed a single ulcer in 16 (76.19%), multiple ulcers in 5 (23.8%), polypoidal lesion in 1 (4.7%) and circumferential ulcer in 2 (9.5%). 3 (14.28%) patients had rectal ulcer resembling malignancy on endoscopy such as everted edge 1 (4.7%) and hard growth 2 (9.5%). Endoscopic biopsy from one such patient was reported as adenocarcinoma for which abdominoperineal resection was done. The final histopathological report of the resected specimen was SRUS. **Conclusion:** SRUS is a misnomer with a potential for misdiagnosis as carcinoma. Under reporting may result in progression of disease and over reporting is disastrous for low rectal lesions.

Index Terms- Bleeding per rectum, Carcinoma, Constipation, Solitary rectal ulcer syndrome.

I. INTRODUCTION

T Solitary rectal ulcer syndrome is a benign condition with chronic ischemia as the most plausible of the several speculated aetiologies^[1].

- The clinical presentation is neither distinctive nor specific to the condition. The symptoms are varied and include rectal bleeding, constipation, straining at stools, diarrhoea and abdominal pain. The endoscopic features range from a spectrum of solitary ulcer to polypoidal lesions. 10% have more than one lesion^[2]. The distinctive but not pathognomonic histologic feature of SRUS is colitis cystica profunda i.e. mucous filled glands misplaced into the sub mucosa or muscularis mucosae and lined with normal colonic epithelium (Fig. 1).
- SRUS is a great masquerader of other serious conditions including adenocarcinoma, inflammatory bowel disease, dysplasia and adenomatous polyp. To error in diagnosis has the potential for treatment disasters, especially if surgical options are considered for low rectal lesions.
- Conservative treatment includes bulking agents, sphincter bio feedback training^[3] and topical mesalamine. Coagulating the lesion using Argon plasma^[4] has also been tried.

Surgical procedures are reserved for non responders with transanal Delorme mucosal resection^[1], stapled transanal rectal resection (STARR)^[5] and abdominal prolapse repair being the most frequently performed. Despite treatment, up to 30 % of patients with SRUS complain of persistent disturbance to anorectal function and significant compromise in their quality of life.

- This study presents the diagnostic and therapeutic dilemma in management of SRUS.

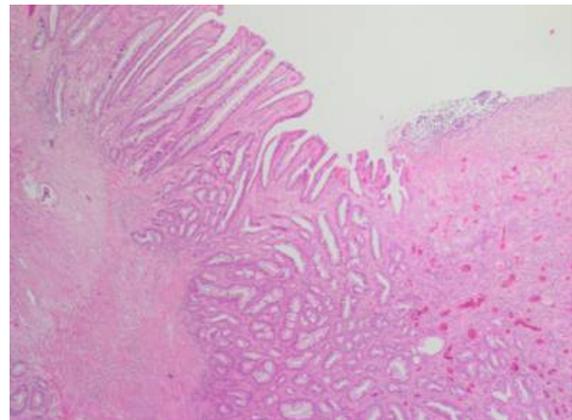


Figure 1: Colitis cystica profunda in solitary rectal ulcer syndrome (H & E staining x 10)

II. OBJECTIVE

- To study clinical, endoscopic, histological and treatment spectrum of solitary rectal ulcer syndrome and to analyze the diagnostic and therapeutic dilemma in its management.

III. METHODS

- This is a retrospective analysis of 21 patients with histopathologically proven SRUS, diagnosed at Kasturba Hospital, Manipal a tertiary care referral hospital in the West coast of South India.
- Clinical records of patients diagnosed between 2011 January to 2012 December were retrieved from the computerized filing system of the medical records department.
- The details of clinical presentations, endoscopic findings, treatment given and

progress during follow up was compiled using a proforma.

IV. RESULTS

- During the study period we had 21 patients with histopathologically proven diagnosis of SRUS. 7 (33.3%) were less than 20 years of age and 4 (19%) were above 60 years of age. The mean age was 48.5 years. 14(66.6%) were males and 7(33.3%) were females. 15(71.42%) had bleeding per rectum as the presenting complaint, constipation in 5(23.8%), passage of mucous in 5(23.8%), abdominal pain in 6(28.57%), diarrhoea in 5(23.8%) and mass per rectum in 2(9.5%). Associated hemorrhoids were seen in 3(14.2%) and rectal prolapse in 1(4.7%).
- The endoscopic findings are summarized in table 1. SRUS resembling malignancy on endoscopy was noted in 3(14.28%) of which 1(4.7%) had the biopsy consistent with malignancy. The aforementioned patient was a 28 year old female, who presented with bleeding per rectum for 3 months. Sigmoidoscopy revealed a circumferential indurated ulcer 4 cm from the anal verge, biopsy being reported as adenocarcinoma. She underwent abdominoperineal resection (Fig.2) with an uneventful post operative period. Final histopathology showed an ulcerated lesion extending into the submucosa with features suggestive of solitary rectal ulcer with no focus of carcinoma in situ or invasive carcinoma.



Figure 2: Resected specimen of the above patient.

Table 1: Endoscopic findings of patients with SRUS (n = 21)

Number	Solitary	16(76.19%)
	Multiple	5(23.8%)
Pattern	Ulcerative	20(95.23%)
	Polypoidal	1(4.7%)
Location	Anterior	1(4.7%)
	Posterior	2(9.5%)
	Circumferential	2(9.5%)
	Data not available	16(76.19%)
Distance from anal verge	<5 cm	3(14.28%)
	5 – 10 cm	5(23.8%)
	>10 cm	13(61.9%)
Diameter	<1 cm	3(14.28%)
	1 – 3 cm	10(47.61%)
	>3 cm	8(38.09%)
Features suggestive of malignancy	Everted margin of ulcer	1(4.7%)
	Hard growth	2(9.5%)
Features suggestive of inflammation	Edematous mucosa	2(9.5%)

- Bulk laxatives alone was prescribed for 9(42.85%), mesalamine for 5(23.8%) and argon plasma coagulation (APC) was tried in 5(23.8%) patients. Low anterior resection was done in 1(4.7%) and abdominoperineal resection in 1(4.7%) patient.
- Nine patients were followed up for 18 months. Others were lost for follow up. Out of 9 patients on follow up, 3(33.3%) had no recurrence of symptoms, 2(22.2%) patients had symptom free period of 1 year, 3(33.3%) patients had symptom free period of 6 months, 1 (11.1%) patient did not have any relief of symptoms(Table 2).

Table 2: clinical outcome and treatment modalities (n = 9)

Clinical Outcome	No Of Patients	Treatment Modalities
No Recurrence	3	Anterior resection (1), APR(1), Bulk laxative(1)
Recurrence in 1yr	2	APC with mesalamine (2)
Recurrence in 6 months	3	Bulk laxative (1), mesalamine (2)
No Improvement	1	Bulk laxative (1)

V. DISCUSSION

- The aetiology for SRUS is ill understood and of the several postulates, chronic straining at stools with ischaemic ulceration seems the most plausible. SRUS has also been associated with high anal pressure due to altered ability to completely evacuate the contents of rectum i.e., obstructed defecation of varying degrees, in paradoxical puborectalis contraction, internal anorectal intussusception and descending perineal syndrome [6]. Mechanical trauma due to self digitation to assist evacuation has also been implicated.
- In the current study SRUS was seen to occur in all age groups with a slight predominance in young, with wide range between 6 to 91 years. Other series have also reported such a variance in age at presentation suggesting that no age predilection exists. Our study revealed a male predominance 14(66.6%) though no definite sex predilection is discernible when all other published series are considered [1, 2, and 7].
- Rectal bleeding was the most common presenting symptom in 15(71.42%) patients which is in agreement with other studies [2, 7]. SRUS presenting as massive rectal bleeding have been reported. Other symptoms reported were constipation, mass protruding through anus, passage of mucous, abdominal pain, tenesmus and diarrhoea but these are neither specific nor distinctive. Rectal prolapse was seen in only 1(4.7%) patient in the paediatric age group and reflects the lack of paediatric patients in our series. In other series that include a larger proportion of paediatric patients [8] rectal prolapse was a common association. The presence of overt rectal prolapse in children may be attributable to diastases of levator ani.
- Endoscopically, solitary lesions were recorded in 16(76.19%) patients and multiple lesions in 5(23.8%) patients. Other series [7] report a marginally higher incidence of multiple lesions. It is evident that SRUS does not always imply the presence of only a single lesion as there can be multiple, polypoidal or circumferential lesions as well. Ulcers are usually placed anteriorly¹ because anterior rectal mucosa is more mobile and the initial part of an intussusceptum, as it descends downward into the anal canal [9].
- The size of the lesion varied from 0.5 to 5 cm in its greatest dimension. The significance of size of the ulcer is yet to be established. 1(4.7%) patient had a polypoidal lesion in our study. Other series have also reported a similar incidence with the exception of Ortega AE who reported 74% polyp or mass [3]. Distance of ulcer from anal verge ranged from 4cm to 20cm as has been seen with other series [1, 2]. It can be present in the sigmoid colon also. In the current study, 2(9.5%) patients had associated polyps in the terminal ileum; both were less than 20 years of age. It may be an incidental finding, which needs further evaluation to establish any co-relation. No other reports exist regarding this finding, most series having no comment on the ileum. Either the ileum was not evaluated or the finding was not correlated with SRUS.
- SRUS may mimic a malignant ulcer with a hard growth and everted edge. The current study had 3(14.28%) patients with endoscopic features suggestive of carcinoma. Other series and case reports have suggested that SRUS may appear as malignant on endoscopy [9]. Cornerstone histological features of SRUS are fibromuscular obliteration of lamina propria with splaying of muscularis between the crypts and diffuse collagen infiltration of lamina propria. They are not pathognomonic of SRUS but most consistent with it. Decussation and thickening of the two muscle layers, nodular induration of the inner circular layer and grouping of outer longitudinal layer are unique to SRUS. 'Diamond shaped crypts' is a salient feature of in SRUS [10]. Biopsy and histopathology may not settle the diagnostic dilemma nor provide clarity regarding further management. Colitis cystica profunda is characterized by presence of benign columnar epithelium and mucous cysts residing deep to muscularis mucosae, this histologic pattern may be confused with invasive adenocarcinoma [11].
- When severe dysplasia is reported, the surgeon may suspect under reporting because the clinical picture is suggestive of malignancy. The pathologist may even be overly cautious in reporting malignancy. The patient then becomes a candidate for abdomino perineal resection with permanent colostomy. In the current study 2 out of 3 patients had their slides send to other centers for a second opinion, due to discordance between the clinical findings and the histopathology report. The diagnosis of SRUS was confirmed and a debilitating surgery like abdominoperineal resection was avoided. However, one patient underwent abdominoperineal resection based on the diagnosis of adenocarcinoma in the endoscopic biopsy and a clinical picture suggestive of malignancy; only to find that the final histopathological report showed SRUS. This event is exceptional and rare, but makes it mandatory to get a second opinion of slides when SRUS is considered even a remotely possible diagnosis.
- A school of thought which believes that SRUS has the potential to progress to malignancy exists. It is supported by loss of hMLH1 gene expression in several cases of SRUS [10].
- Patients presenting with obstructed defecation or bleeding per rectum may require colonoscopy and rectal biopsy, followed by defecography and dynamic MRI of pelvis. The former can demonstrate recto rectal intussusceptions and the latter can reveal anorectal redundancy, lack of mesorectosacral fixation and mild to severe pelvic floor descent. Anorectal manometry, balloon expulsion test, electromyography, nerve stimulation, transit studies and endoultrasound may all contribute to diagnosis [12]. Anal endoultrasound shows marked thickening of internal sphincter, which is a striking feature of SRUS. A study using endorectal ultrasound and MRI was done

preoperatively to stage patients diagnosed to have rectal cancer based on endoscopic findings. Eight of them were diagnosed as malignant, but final biopsy was reported as SRUS^[13]. The chances of misdiagnosis are high.

- A variety of medical treatment^[7] options exist. In the current study mesalamine was used to treat SRUS in 5(23.8%) patients, bulk laxatives in 9(42.85%) patients and argon plasma coagulation (APC) in 5(23.8%) patients. Patients opting for APC may be required to undergo 4-8 sessions to achieve alleviation of symptoms^[4]. Response of patients on laxatives is varying from complete remission to no improvement of the symptom. Laxatives may not help patients with rectal prolapse or internal intussusceptions. Laxatives do not treat the aetiology. One study stated that oral salicylate or topical mesalamine and steroids are not effective^[14]. Behavioural modification or bio feedback therapy, which includes bowel habit training, avoiding excessive straining and normalization of pelvic floor co-ordination may improve symptoms, anorectal function and also facilitate healing of SRUS. Randomized control trials have established that SRUS caused by dyssynergic defecation can be effectively treated by bio feedback therapy^[3]. Behavioural modification requires follow-up reinforcing to have long term remissions. Injection of botulinum toxin into external anal sphincter is effective for a period of three months in treatment of SRUS and constipation associated with dyssynergia of defecation^[14]. Overall 66.6% of patients in our study had at least a minimum symptom free period of 6 months with conservative measures but recurrence is common.
- Surgery is restricted to non responders with full thickness rectal prolapse and intractable bleeding despite conservative management^[1]. Stapled transanal rectal resection (STARR), rectopexy or Delorme's procedure are reported to have the best success rates. 1(4.7%) patient in our series who underwent low anterior resection was completely relieved of all symptoms and had no recurrence. Laparoscopic ventral mesh rectopexy (LVMR) for internal and external prolapse causing SRUS has shown to heal the ulcer and improve the quality of life^[15].
- Defaecography and anorectal manometry were not done in the current study, hence limiting the aetiology oriented treatment. A large volume prospective study is required to draw definitive conclusions.

VI. CONCLUSION

- Solitary rectal ulcer syndrome is a misnomer because lesions may be multiple and even occasionally polypoidal.
- There is no true syndromic association except that its etiopathogenesis is ill understood and multi factorial. Though bulk laxatives, biofeedback sphincter training, topical mesalamine

and argon plasma coagulation are all useful in conservative therapy for SRUS, persistence of symptoms and relapses are common. Surgical treatment is reserved for non responders.

- SRUS may on occasion simulate malignancy both in macroscopic appearance at endoscopy and on histology of endoscopic biopsies. Hence, it is important to carefully review the endoscopic biopsy specimens to avoid performing inappropriate radical surgery with attendant major morbidity.

REFERENCES

- [1] nt strategies in obstructed defecation and fecal incontinence. *World J Gastroenterol* 2006; 12(20): 3168 – 3173.
- [2] Al-Brahim N, Al-Awadhi N, Al-Enezi S et al. Solitary Rectal Ulcer Syndrome : A Clinicopathological Study of 13 cases. *Saudi J Gastroenterol* 2009; 15(3): 188-92. doi: 10.4103/1319-3767.54749
- [3] Schey R, Cromwell J, Rao SS. Medical and surgical management of pelvic floor disorders affecting defecation. *Am J Gastroenterol* 2012; 107(11): 1624-33. doi: 10.1038/ajg.2012.247
- [4] Somani SK, Ghosh A, Avasthi G, Goyal R, Gupta P. Healing of solitary rectal ulcers with multiple sessions of argon plasma coagulation. *Digestive endoscopy* 2010; 22(2):107-111. doi: 10.1111/j.1443-1661.2010.00941
- [5] Ortega AE, Klipfel N, Kelso R, Petrone P, Roman I, Diaz A, et al. Changing concepts in the pathogenesis, evaluation, and management of solitary rectal ulcer syndrome. *Am Surg* 2008; 74(10): 967-72.
- [6] Morio O, Meurette G, Desourneaux V, D'Halluin PN, Bretagne J, Siproudhis L. Anorectal Physiology in Solitary ulcer syndrome: A case-matched series. *Dis colon Rectum* 2005; 48:1917-1922.
- [7] Chong VH, Jalihal A. Solitary rectal ulcer syndrome: characteristics, outcomes and predictive profiles for persistent bleeding per rectum. *Sing Med J* 2006; 47(12): 1063-1068.
- [8] Suresh N, Ganesh R, Sathiyasekeran M. Solitary Rectal Ulcer Syndrome: A Case Series. *Indian Pediatr* 2010; 15: 1059-1061.
- [9] Perrakis E, Vezakis A, Velimezis G, Filippour D. Solitary rectal ulcer mimicking a malignant stricture. *Rom J Gastro* 2005; 14(3): 289-291
- [10] Abid S, Khawaja A, Bhimani S A, Ahamad Z, Hamid S,Jafri W. The clinical, endoscopic and histological spectrum of solitary rectal ulcer syndrome: a single-center experience of 116 cases. *BMC gastroenterol* 2012; 12: 72 1-6. doi: 10.1186/1471-230X-12-72
- [11] Fry R D, Mahmoud N, Maron D J, Ross H M, Rombeau J. Colon and rectum. In: Townsend C M, Beauchamp R D, Evers B M, Mattox K L, eds. *Sabiston Textbook of surgery*.vol 2. 18th ed. Noida, U.P (India). Elsevier. 2008. p 1412.
- [12] Rosen A. Obstructed defecation syndrome: Diagnosis and therapeutic options, with special focus on the STARR procedure. *IMAJ* 2010; 12: 104-106.
- [13] Blanco F, Frasson M, Flor-Lorente B, Minguez M, Esclapez P, Granero E. Solitary rectal ulcer: Ultrasonographic and magnetic resonance imaging patterns mimicking rectal cancer. *Eur J Gastroenterol Hepatol* 2011; 23(12):1262-1266. doi: 10.1097/MEG.0b013e32834b0dee
- [14] Dehghani S M, Malekpour A, Haghigat. Solitary rectal ulcer syndrome in children: A literature review. *World J Gastroenterol* 2012; 18(45): 6541-6545. doi: 10.3748/wjg.v18.i45.6541
- [15] Badrek-Amoudi A, Roe T, Mabey K, Carter H, Mills A, Dixon A. Laparoscopic ventral mesh rectopexy (LVMR) in the management of solitary rectal ulcer syndrome (SRUS): a cause for optimism. *Colorectal Dis* (in press) 2012.doi:10.1111/codi.12077.

AUTHORS

First Author –Dr. Odaiyappan Kannappan, M.S, MRCS (Ed),DNB, FRCS (Eng), Assistant professor, Dept of General Surgery, KMC, Manipal, Manipal University

Second Author – Dr.Stanley Mathew, MS, DNB, FRCS (Ed), Professor and Unit Chief, Dept of General Surgery, KMC, Manipal, Manipal University .

Third Author – Dr.Ravikiran Naalla, MS, Senior resident, Dept of General Surgery,KMC, Manipal, Manipal University .

Correspondence Author – Dr. Odaiyappan Kannappan, k_odaiyappan@rediffmail.com.

Relationship between Homocysteine and Vitamin B₉ Level in Male CHD Patients and Compare with Normal Healthy Male Subjects

Sharma Hemlata¹, Vyas Shalini², Dr. Vyas R.K.³, Dr. Chhapparwal Amit⁴

^{1,2}M.Sc.(medicine) Biochemistry, Biochemist, Department of Biochemistry, S.P. Medical College, Bikaner.

³PhD Biochemistry, professor & head, Department of Biochemistry, S.P. Medical College, Bikaner.

⁴M.D.S., Assistant Professor, Geetanjali dental college and research institute, Udaipur.

Abstract- Present study conducted on coronary heart disease patients. plasma homocysteine concentrations and relationships to vitamin B₉ that serve as coenzymes in homocysteine metabolism. Results showed that homocysteine exhibited strong inverse association with plasma folate. plasma homocysteine level varied from 6.8 to 18.7 μmol/L with mean as 12.92 ± 3.61 μmol/L in normal control male subject. The mean plasma homocysteine level was increased to 18.89 ± 2.24 μmol/L with a range of 14.0 to 21.51 μmol/L in normal control males subjects aged between 46-70 year, increase in the homocysteine level was statistically significant as compared to that of normal subjects above stated as evident by P-value (P < 0.001). The mean plasma Homocysteine level was found to be 23.48 ± 1.62 μmol/L with a range of 20.64 to 25.54 μmol/L in CHD male subjects aged between (25 to 45 years). The increase Plasma homocysteine concentration in CHD patients was statistically significant as compared to normal control more subjects with age difference as evident by P-Value (P < 0.001). The increase was statistically highly significant as compared to control group. while it ranged from 6.80 to 21.51 μmol/L as evident by P-value (P < 0.001). CHD. The mean serum folic acid (vit. B₉) level was found to be 6.98 ± 1.54 ng/ml with a range of 4.82 to 9.12 ng/ml in normal control male subjects aged between 25 to 45 years. Plasma homocysteine and vitamin B₉ was estimated by high performance liquid chromatography. Estimation of homocysteine and serum vitamin B₉ is reliable, economic and sensitive and it can be used in proper management of chronic complications of coronary heart disease. HPLC grade kits.

Index Terms- Coronary heart disease, homocysteine vitamin B₉, HPLC.

I. INTRODUCTION

The main forms of CVD are coronary heart disease (CHD) and stroke. About half of all deaths from CVD are from CHD and about a quarter are from stroke^[1] Coronary artery disease has become a major health problem and is the most common cause of mortality and morbidity in the entire world^[2]. Cardiovascular disease is the leading cause of death and disability in the developed nations and is increasing rapidly in the developing world^[3]. Hyperhomocysteinemia is defined as total Homocysteine concentration elevated above 15 μmol/L. Hyperhomocysteinemia has been strongly associated with the

pathogenesis of coronary vascular disease, and correspondingly has been identified as a contributing factor in four main disease mechanisms including thrombosis, vascular oxidative stress, apoptosis and cellular proliferation.^[4-6] Impaired enzyme function as a result of Genetic mutation or deficiency of the B vitamins folic acid, vitamin B₁₂, and B₆ can lead to hyperhomocysteinemia. Oxidized forms of Homocysteine account for 98-99% of total plasma Homocysteine although there is un certainty as to whether increased Homocysteine is casual or merely a proxy for cardiovascular disease, several lines of evidence suggest that it may play a role in atherothrombotic disease. Homocysteine appears to alter the anticoagulant properties of endothelial cells to a procoagulant phenotype. Mildly increased Homocysteine causes dysfunction of the vascular endothelium. folic acid effectively lowers Homocysteine concentration in the plasma. Intervention studies are urgently needed to determine if lowering Homocysteine is effective in decreasing the morbidity and mortality of cardiovascular disease.^[7]

II. MATERIAL & METHODS

The present study was conducted on 50 patients of coronary heart disease of HRMC, S.P. Medical college, Bikaner and 50 persons are healthy subjects between the age group 25-70 years of both sexes.

Determination of plasma homocysteine- For the determination of homocysteine, the sample is reduced and derivatized in one step. The albumin bound and the oxidized homocysteine is reduced. During a precipitation step high molecular substances are removed and analysed by high performance liquid chromatography with uv detector.

Determination of Serum vitamin B₉- Detection was performed with a photodiode array detector monitoring the eluent 280 nm for folic acid. Identification of resolved peaks in real samples was executed by comparing their spectra with those derived from aqueous standard solutions. For the determination of vitamin B₉, the sample is reduced and derivatized in one step. HPLC injection the values of different parameter in different subjects were obtained with the help of uv detector.

III. RESULTS

The plasma homocysteine level was found to be $30.42 \pm 10.10 \mu\text{mol/L}$ with a range of $16.04\text{-}46.66 \mu\text{mol/L}$ in CHD. The increase was statistically highly significant as compared to control group with $14.95 \pm 14.95 \mu\text{mol/L}$; while it ranged from 6.80 to $21.51 \mu\text{mol/L}$ as evident by P-value ($P < 0.0001$). The serum folic acid (vit. B₉) level was found to be 3.64 ± 1.23

ng/ml) with a range of 1.25 to 6.72 ng/ml in CHD subjects. The decrease level of folic acid (vit. B₉) was statistically highly significant as compared to control subjects with 4.90 ± 1.94 ng/ml; while it ranged from $1.86\text{-}9.12$ ng/ml as evident by P-Value ($P < 0.0002$). The results of present study of folic acid (vit. B₉) was similar to results obtained by previous studies.

Plasma homocysteine level by age and sex group in patients of CHD and Control

AGE GROUP (years)	Group	Sex	Plasma Homocysteine level ($\mu\text{mol/L}$)					
			Mean	SD	SE	Df	t vale	p value
25-45	Patients (25)	Male (15)	23.48	1.62	0.42	98	18.87	0.0001 HS***
		Female (10)	20.21	3.25	1.03	98	18.85	0.0001 HS***
	Control (25)	Male (15)	12.92	3.61	0.93			
		Female (10)	10.44	1.69	0.53			

* Significant
 ***Highly Significant
 Df = Degree of Freedom

Serum Vitamin B₉ (Folic acid) level by age and sex group in patients of CHD and Control

AGE GROUP (years)	Group	Sex	Vitamin B ₉ (Folic acid) level (ng/ml) in Serum					
			Mean	SD	SE	Df	t vale	p value
25-45	Patients (25)	Male (15)	4.03	1.35	0.35	98	0.18	0.0001 HS***
		Female (10)	2.49	0.78	0.25	98	7.86	0.0001 HS***
	Control (25)	Male (15)	6.98	1.54	0.40			
		Female (10)	4.36	1.49	0.47			

* Significant
 ***Highly Significant
 Df = Degree of Freedom

IV. DISCUSSION & CONCLUSION

A statistically significant increased concentration of plasma homocysteine was recorded in CHD (male) patients age between 25-45 years as well as in the whole group as compared to that of normal control male subjects with same age difference. It might be possible that elevated plasma total homocysteine levels have been positively associated with ischemic stroke risk. The serum vitamin B₉ (Folic acid) concentration was found to be decreased significantly in CHD (Male) patients aged between 25-45 years as well as in the whole group as compared to the normal control male subjects with same age difference. It might be possible that high dose of folic acid will improve endothelial function, reduce coronary artery plaque size and reduce coronary artery

retention. Homocystinuria means elevated tHcy concentration observed in these patients and significantly reduce cardiovascular events and present the formation of Atherosclerosis. Low dose folic acid reduce plasma tHcy, but a high dose may be required to produce the beneficial effects on vascular function report by stuart et al (2003)^[10]. The result of present series of study resembled with findings of yaps et al (2001)^[8] and stores et al (2012)^[9].

REFERENCES

[1] Petersen S, Peto V, Scarborough P, Rayner M. 2005 Coronary Heart Disease Statistics - 2005 edition, British Heart Foundation Health Promotion Research Group, Department of Public Health, University of Oxford, 2006. Available online at: <http://www.heartstats.org>

- [2] Reddy KS Cardio vascular disease in india,world health stats organi,1993;46:101-7.
- [3] Fleming RM Angina and coronary ischemia are the result of coronary regional blood flow differences.J Amer coll Angiol,2003;1:127-142.
- [4] Al-Obaidi- M K, P J Stubbs, R Amersey,M I M Noble. (2001), Acute and convalescent changes in plasma homocysteine concentrations in acute coronary syndromes, Heart 2001;85:380.384.
- [5] Lubos, E., Lasclazo, J., & Handy, D. : Homocysteine and glutathione peroxidase-1.Antioxid. Redox. Signal , 2007;1923-1940
- [6] Coldea Agoston - Lucia, Teodora Mocan, Marc Gatifosse, Silvia Lupu, Dan L. Dumitrascu Plasma homocysteine and the severity of heart failure in patients with previous myocardial infarction Cardiol J; 2011;18, 1: 55.62.
- [7] Donald DW, Jacobsen Clinical chemistry 1998;44:1833-1843
- [8] Yaps, Bores GH, Wilcken DE et al Vascular outcome in patients with homocysteineuria due to cystathionine β synthase deficiency treated chronically:A multicenter observational study.Arterioscler Thromb. Vasc Biol 2001;21:2080-2085.
- [9] Yaps, Bores GH, Wilcken DE et al Vascular outcome in patients with homocysteineuria due to cystathionine β synthase deficiency treated chronically:A multicenter observational study.Arterioscler Thromb. Vasc Biol 2001;21:2080-2085.
- [10] Yaps, Bores GH, Wilcken DE et al Vascular outcome in patients with homocysteineuria due to cystathionine β synthase deficiency treated chronically:A multicenter observational study.Arterioscler Thromb. Vasc Biol 2001;21:2080-2085.

AUTHORS

First Author – Hemlata Sharma is biochemist, Department of Biochemistry in S.P. Medical College, Bikaner (Rajasthan), India. she had also worked as a senior demonstrator Department of Biochemistry in Dr. S.N. Medical College, Jodhpur (Rajasthan), India.

Effect of mycorrhizae, NPK and compost on vegetative and reproductive parameters of soybean (*Glycine max* L)

Dahanayake Nilanthi and Alawathugoda CJ

Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka

Abstract- Soybean (*Glycine max* L: Fabaceae) is a mycotrophic (mycorrhizal) legume grown commercially for human consumption. It is a major grain legume cultivated in Sri Lanka. The greenhouse experiment was conducted to determine the influence of mycorrhizae as a substitute for inorganic fertilizer on growth and yield of Soybean (*Glycine max*) and observe how mycorrhizae inoculation affect to yield of soybean and soil microbial activity in drought condition.

Five different fertilizer mixtures; mycorrhizae, sterilized field soil with compost, Mycorrhizae, Sterilized field soil with standard dose of NPK, Sterilized field soil and compost and Strilized field soil and standard dose of NPK, non sterilized soil (control) were used. Each treatment was irrigated with three different water levels; 50ml, 100ml and 200ml per day. Experiment conducted in a Factorial Complete Randomized Design with three replicates. Statistical analysis was carried out using the Student Newman-Kuells Means Separation Test of SAS program (9.1.3).

Results indicated that significantly highest number of pods per plant was recorded in potting mixtures; mycorrhizae+sterilized soil+compost (22 pods/ plant) and sterilized field soil+compost (20 pods/ plant) comparing to other all treatments. There is no any interaction between water levels with application of mycorrhizae for all measured growth and yield parameters of soybean. However significantly different growth and yield parameters were observed in various potting mixtures and as well as 3 types of water levels. Mycorrhizae increase the soil microbial activity significantly comparing with field soil and potting mixture with inorganic fertilizer.

Index Terms- Mycorrhizae, Inorganic fertilizer, Soybean

I. INTRODUCTION

Inorganic fertilizer application enhances plant growth and yield because it absorbs quickly to soil and plants. Therefore farmers applied maximum amount of inorganic fertilizer to their crops to achieve higher yield. As a result of the excess inorganic fertilizer leaches to the ground water table it has to pollute. To avoid this situation, combination of inorganic fertilizer with biological ingredients is better to use in crop cultivation (Urban Creeks Council, 2001). Mycorrhiza (family: Endogone) is a type of organic fertilizer/bio fertilizer that creates mutuality symbiosis between mycorrhizal fungi and higher plants. Mycorrhizae improves crop yield and increases the use of inorganic fertilizer by forming a bridge between the roots and the soil (University of Washington, 2006). It is indirectly enhancing the structure of the soil and improves air and water infiltration.

Soybean (*Glycine max* L: Fabaceae) is a mycotrophic (mycorrhizal) plant native to East Asia. It is much depended on mycorrhizal symbiosis, classified as mycotrophic plant. Soybean being a profitable crop that grown commercially for human consumption. At present soybean is one of the five major grain legumes cultivated in Sri Lanka. It is recognized as a potential food crop that can bridge the gap between the national needs and the availability of protein, as well as edible oil requirement in Sri Lanka (Arulandy, 1995).

Virtually all plant taxa have well-established symbioses with a large variety of microorganisms. Mycorrhizae are known to stimulate plant growth and nutrient absorption and enhance the drought tolerance. Plants colonizing mycorrhizae might improve soil quality and natural interactions in the soil (Auge, 2001). Therefore the hypothesis of the present study was mycorrhizae inoculation to the Soybean grown soils will alleviate the water stress of Soybean.

II. MATERIALS AND METHOD

Study was conducted at Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya (low country ,16m from sea level) wet zone (WL₂) where the annual rainfall is greater than 1,900 mm. The mean monthly temperature is 27.5⁰C and relative humidity is around 72%.

Soybean (variety PM 25) seeds were obtained by Department of Agriculture. Pots were filled with potting media and sterilized using Dimethyl [(1,2-phenylene)bis-(iminocarbonothioyl) fungicide (400g/l EC) . After sterilization, pots were kept wet for seven days. Seeds were covered by thin soil layer and watering was done daily. After twenty one days of nursery period, healthy same size (5cm) seedlings were kept in the pots and maintained three plants per pot. Thinned out weaker plant after 10-12 days and remained two plants in each pot.

Five different fertilizer mixtures; mycorrhizae andsterilized field soil with compost (M+C), Mycorrhizae andsterilized field soil with standard dose of NPK (M+NPK), Sterilized field soil withcompost (SS+C) and Strilized field soil with standard dose of NPK (SS+NPK), non sterilized soil (control) were used. Standard dose of mycorrhizae and NPK (2g mycorrhizae/5L water, NPK- 35:130:35 respectively) was used. Each treatment was irrigated with three different water levels; 50ml, 100ml and 200ml per day.

All management practices were conducted according to recommendations of the Department of Agriculture from seed germination to harvesting. Soil microbial activity was measured according to the CO₂ evolution method.

After 8 weeks plants were harvested. Number of leaves per plant at 25 days, number of leaves per plant at 45 days, shoot length, number of pods per plant, wet weight of pod per plant, plant wet weight, and were measured. Treatments were undertaken in Factorial Complete Randomized Design to avoid any biases and make better estimation of treatment effect. Each treatment was replicated five times. Data were analyzed using SAS program (9.1.3).

III. RESULTS AND DISCUSSION

There is no any interaction between water levels with application of mycorrhizae for all measured growth parameters of soybean. However significantly different growth and yield parameters were observed in various potting mixtures and 3 types of water levels (Fig 1 and 2, Table 1). When consider all treatments which we practiced; at the lower water levels in soil significantly decreased all growth parameters of soybean (Table 2 and Fig 3).

When consider average values of leaf number per plant at 25 days (beginning of vegetative stage) and after 45 days (end of the vegetative stage) in all water levels significantly higher number was observed in potting mixtures; mycorrhizae+sterilized soil+compost and mycorrhizae+compost+inorganic fertilizer where mycorrhizae was applied.

The significantly highest plant wet/fresh weight was observed at the potting mixture Sterilized field soil+ compost (19.4g) and 200ml water level (12.6g).

More root nodules were observed in potting mixture mycorrhizae+sterilized soil+compost comparing to the other all treatments. The adding of compost could increase the soil porosity and decrease the mechanical soil resistance to the growth of mycorrhizae. In the potting mixture mycorrhizae+compost+inorganic fertilizer didn't observe nodules due to inorganic fertilizer may inhibit the growth of mycorrhizae. Same results also reported Smith *et al*, 2010 when synthetic fertilizer was present reduced the arbuscular mycorrhizal colonization. Addition of compost would increase the soluble organic matter content in the soil. This would be the result of increased mycorrhizae growth and initiate root nodules.

Shoot length of the plant also affected positively with increasing the water levels but it was not significant In the treatments with mycorrhizae inoculums, addition mycorrhizal hyphae might improve nutrient and water absorption to the plants through roots.

As indicated in Table 1 highest number of pods per plant was recorded in potting mixtures; mycorrhizae+sterilized soil+compost (22 pods/ plant) and Sterilized field soil+compost (20 pods/ plant). The lowest mean number of pods was recorded in (11 pods/soybean plant) when used non sterile field soil as the potting medium.

Highest wet weight of pods/plant was recorded in sterilized field soil+compost potting medium (11g/ plant) comparing to other all treatments. Lowest wet weight was recorded in non sterilized field soil (5.2g/ plant) and it was not significantly different from potting medium Sterilized field soil + standard dose of NPK (5.6g/ plant).

Highest microbial activity (emitted CO₂ mg/kg of soil) was observed in potting medium mycorrhizae+sterilized soil+compost (600 CO₂ mg/kg soil) and it was significantly different from all other treatments (Fig. 4). Rod, R (2005) was observed mycorrhizal fungi constitute the dominant micro-organisms in most undisturbed soils estimated at about 70% of microbial biomass. However potting medium, mycorrhizae+compost+inorganic fertilizer was reduced (300 CO₂ mg/kg soil) microbial activity by 50% comparing to mycorrhizae+sterilized soil+compost. The same results were observed by Seran *et al* 2010 soil micro and macro organisms are reduced with the presence of inorganic fertilizers as compared to organic fertilizers.

Table 2. Effects of different water levels on the growth and yield of Soybean

Treatment	Shoot length (cm)	Number of pods/plant	Pod wet weight (g)	Plant wet weight (g)
W ₁	78.3 a	12.8 c	5.8 b	9.7 b
W ₂	78.1 a	15.4 b	6.6 b	10.7 b
W ₃	84.5 a	21.7 a	9.2 a	12.6 a

Column values followed by the same letter are not significantly different as determined by Duncan's multiple range test (P=0.05). Values in same column with same letter denoted non-significant difference

IV. CONCLUSION

Highest number of pods per plant was recorded in potting mixtures; mycorrhizae+sterilized soil+compost (22 pods/ plant) and sterilized field soil+compost (20 pods/ plant) comparing to other all treatments.

Addition of mycorrhizae increases the soil microbial activity significantly comparing with potting mixtures with inorganic fertilizer, sterilized soil with compost and field soil

REFERENCES

- [1] Arulandy, V (1995), Breeding soybean varieties for Sri Lankan conditions, Retrieved November 06, 2012, From agrillearning.goviya.lk/Pulses/research/soya/So4.pdf
- [2] Auge, R. M. (2004). Arbuscular mycorrhizae and soil/plant water relations. *Can. J. Soil Sci.* 84, 373-381.
- [3] Rod, R (2005), Understanding mycorrhizal fungi, Retrieved August 07, 2012, from www.carbonlink.com.au/data/files/downloads/understanding_mycorrhizal_fungi.pdf
- [4] Seran, TH, Srikrishnah, S, Ahamed, MMZ 2010. Effect of different levels of inorganic fertilizers and compost as basal application on the growth and yield of onion (*Allium cepa* L.), *The Journal of Agricultural Sciences*, vol. 5, no 2
- [5] Smith SE, Smith FA (2010) Roles of arbuscular mycorrhizas in plant nutrition and growth: new paradigms from cellular to ecosystems scales. *Annu Rev Plant Biol* 63: 227–250
- [6] University of Washington (2006), Retrieved August 07, 2012, from <http://green-diamond-biological.com/wp-content/uploads/2012/03/Mycorrhiza-article.pdf5>

[7] Urban Creeks Council n.d., Bio fertilizers and Mycorrhizae, Retrieved August 24, 2012, from <http://www.urbancreeks.org/Biofertilizers.pdf>

Second Author – Alawathugoda CJ, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka

Corresponding author: nilanthi@agbio.ruh.ac.lk

AUTHORS

First Author – Dahanayake Nilanthi, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka

Table 1. Growth parameters of Soybean in different treatments. [mycorrhizae, sterilized soil with compost (T1), Mycorrhizae, strilized field soil with standard dose of NPK (T2), Sterilized field soil and compost (T3) and Strilized field soil and standard dose of NPK (T4), non sterilized soil (control-T5) were used. Standard dose of mycorrhizae (2g mycorrhizae/5L water) was used. Each treatment was irrigated with three different water levels; 50ml (W1), 100ml (W2) and 200ml (W3) per day].

Treatment	Shoot length (cm)	Number of pods/plant	Pod wet weight (g)	Plant wet weight (g)
T ₁ (M+C)	93.4 a	22 a	7.7 b	11.7 b
T ₂ (M+NPK)	77.5 b	16b	6.6 bc	8.9 c
T ₃ (SS+C)	93.7 a	20a	11.0 a	19.4 a
T ₄ (SS+NPK)	73.4 b	15 b	5.6 c	7.5 c
T ₅ (NS)	63.6 c	11 c	5.2 c	6.7 c

Column values followed by the same letter are not significantly different as determined by Duncan’s multiple range test (P=0.05). Values in same column with same letter denoted non- significant difference

Table 2. Effects of different water levels on the growth and yield of Soybean

Treatment	Shoot length (cm)	Number of pods/plant	Pod wet weight (g)	Plant wet weight (g)
W ₁	78.3 a	12.8 c	5.8 b	9.7 b
W ₂	78.1 a	15.4 b	6.6 b	10.7 b
W ₃	84.5 a	21.7 a	9.2 a	12.6 a

Column values followed by the same letter are not significantly different as determined by Duncan’s multiple range test (P=0.05). Values in same column with same letter denoted non- significant difference



Fig 1. Effects of mycorrhizae inoculation to the potting mixture on the growth and development of soybean plant at same water level (100ml/ day).

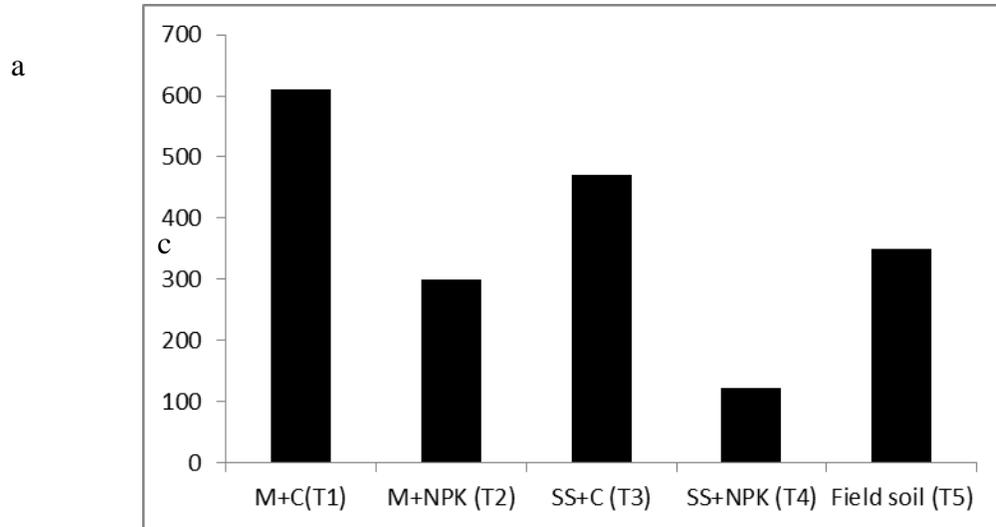


Fig 2. Effects of mycorrhizae inoculation to the potting mixture on the growth and development of soybean pods at same water level (100ml/ day)



Fig 3. Effects water content to growth and development of soybean pods at T3.

Fig 4. Effect of potting mixtures on soil Microbial activity. (Omitted CO₂ concentration mg/kg)



Column values followed by the same letter are not significantly different as determined by Duncan's multiple range test (P=0.05). Values in same column with same letter denoted non-significant difference

Review of major abundant weeds of cultivation in Sri Lanka

Perera, P.C.D. and Dahanayake Nilanthi

Department of Agricultural Biology, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka.

Abstract- Weeds can be defined as unwanted and undesirable plants which are growing out of place. For an example, *Eichhorniacrassipes* (Waterhyacinth) is beautiful in floating gardens but can rapidly log waterways, cause to flood and making navigation impossible. Sri Lanka climate is suitable for weeds to adapt and to persist for survive. Their pattern of spread and adapting features are help to grasp cultivated lands. Sri Lanka has a poor record of managing weeds, largely due to inadequate mechanisms to deal with them early or prevent their entry through border protection. Recent stakeholder consultations identified insufficient funding for on-ground works and for research and the absence of a central coordination mechanism as major constraints. Control options are also limited (i.e. limited array of herbicides or biocontrol agents) and experience is also lacking in implementing large scale integrated weed management programs. To effectively tackle invasive species in Sri Lanka, a National Weed Strategy has been developed. This national framework aims to provide increased weed science education at tertiary level and increased training for government officials and farmers. It also aims provide a mechanism for efficient information sharing and effective multiple stakeholder cooperation and participation in managing weeds across landscapes. This review considers the major weeds in cultivated lands in Sri Lanka and it helps farmers to identify the weeds in their lands and to select weed management techniques according to the morphology of plant.

Index Terms- Weeds, herbicides, bio control agents, National Weed Strategy

I. INTRODUCTION

A weed in a general sense is a plant, usually wild or feral, that is commonly considered to be a nuisance in a garden, lawn, or other agricultural development. More specifically the term is often used to describe plants that grow and reproduce aggressively. Weeds may be unwanted because they are unsightly, or because they limit the growth of other plants by blocking light, space or using up nutrients from the soil. The term weed in its general sense is a subjective one, without any classification value, since a plant or herb is not a weed when growing where it belongs or is wanted[1]. There are numerous definitions of a weed. Some common definitions include[2]:

- A plant that is out of place and not intentionally sown.
- A plant that grows where it is not wanted or welcomed.
- A plant whose virtues have not yet been discovered.
- A plant that is competitive, persistent, pernicious, and interferes negatively with human activity.

No matter which definition is used, weeds are plants whose undesirable qualities outweigh their good points, at least according to humans. Human activities create weed problems since no plant is a weed in nature. Though human may try to manipulate nature for their own good, nature is persistent. Through manipulation, human control certain weeds, while other more serious weeds may thrive due to favorable growing conditions. Weeds are naturally strong competitors, and those weeds that can best compete always tend to dominate[2]. Both humans and nature are involved in plant-breeding programs. The main difference between the two programs is that humans breed plants for yield, while nature breeds plants for survival[2]. This review is going on to identify major weeds in Sri Lanka, how do they control and future weed control strategies in Sri Lanka.

II. MAJOR WEEDS IN SRI LANKA

According to the literature, following shows some evidence for weed problem in Sri Lanka. In Sri Lanka, Water Hyacinth [*Eichhorniacrassipes* (Mart.) Solms.] and *Salvinia* (*Salviniamolesta* D. S. Mitchell) continue to dominate eutrophic waterways in both rural and urban environments. In addition, several other highly invasive species have also recently become problems in waterways, and these include: Alligator Weed [*Alternantheraphiloxeroides* (Mart.) Griseb], Water Spinach *Ipomoea aquatica* Forssk. and *Hydrilla* [*Hydrilla verticillata* (L. f.) Royle]. Infestations of Primrose Willows - *Ludwigia peruviana* (L.) Hara and *L. octovalvis* are increasing in abundance in reclaimed marshlands and drainage canals, while several others (e.g. *L. decurrens* and *L. hyssopifolia*) continue to be major weed problems in rice agriculture. Relatively recent introductions of major global weeds (i.e. Giant Mimosa - *Mimosa pigra* L.; *Parthenium* - *Parthenium hysterophorus* L.; *Austroeuatorium nulifolium* (Kunth)) highlight Sri Lanka's problems [3]. Among the weed species recorded *Cyperus rotundus* was the most dominating species [4]. *Lantana camara* and *Chromolaena odorata* had the highest spread, extending even >25 m into the forests of Mihintale wildlife sanctuary and *Salvinia* was the most abundant aquatic invasive alien plants. Top soil layer contained the highest number of germinable invasive alien plants seeds [5]. Following shows some facts of abundant weeds in cultivated land in Sri Lanka according to the morphology of them.

a) Grasses (family: Poaceae)

Brachiaria mutica (figure 1, A). Common name - Dhiyathana (Sri Lanka). It is a creeping perennial grass with long, coarse stolons. Very hairy, decumbent stems and soft, moderately hairy leaves. Leaf sheath has a densely hairy collar.

Inflorescence is a panicle 6–30 cm long, comprising 5–20 densely flowered racemes. Stolons and branches root are readily at the nodes.

Cenchrusechinatus(figure 1, B). Common name - Kuweinithana (Sri Lanka). It is a clump forming annual grass growing up to 80 cm tall. The grass has barbed burrs.

Chloris barbata(figure 1, C). Common name - Mayurathana (Sri Lanka). They bear inflorescences shaped like umbels, with several plumes lined with rows of spikelets. It is terrestrial, annual, tufted erect or prostrate herb and rooting at nodes. Roots are fibrous, white or brown. Stem is flat, hollow and glabrous. Leaves are alternate spiral, sessile, margin entire or undulate, apex acute, base clasping and parallel-veined. Flowers are bisexual, grouped together in a terminal digitate raceme, sessile, green or brown and petals not visible. Fruit is a nut.

Cynodondactylon(figure 1, D). Common name - KukulAtawara (Sri Lanka). The blades are a grey-green colour and are short. It has a deep root system. The grass creeps along the ground and roots wherever a node touches the ground, forming a dense mat. *C. dactylon* reproduces through seeds, runners, and rhizomes.

Dactyloctenium aegyptium(figure 1, E). Common name - Putu Thana (Sri Lanka). The plant mostly grows in heavy soils at damp sites. Traditional food plant used as a famine food in Africa but in other countries this grass is considered a weed and invasive species. This grass creeps and has a straight shoot which are usually about 30 centimeters tall.

Digitaria ascendens(figure 1, F). Common name - Agilithana (Sri Lanka). It is used as animal fodder. The inflorescences may be reddish or purplish.

Echinochloa crus-galli(figure 1, G). Common name - MahaMaruk (Sri Lanka). This plant can grow to 1.5 meter in height and has long, flat leaves which are often purplish at the base. Stems are flattened at the base. The seed heads are a distinctive feature, often purplish, with large millet-like seeds in crowded spikelets. Considered one of the world's worst weeds, it reduces crop yields and causes forage crops to fail by removing up to 80% of the available soil nitrogen. It acts as a host for several mosaic virus diseases.

Echinochloa glabrescens(figure 1, H). Common name - Maruk/ Bajiri (Sri Lanka). Upright annual grass, 50-100 cm high, with a closely tufted habit in wetlands, but a spreading habit in dry situations. The leaf sheaths clasp the stem tightly and the leaf blades are strap-like, 10-20 cm long and 5-8 mm wide, with a long thin apex.

Eleusine indica(figure 1, I). Common name - Belathana (Sri Lanka). It is coarse, annual, branching at the base, culms ascending or prostrate, smooth leaf sheaths, blades linear and flat or folded. It has two to six spikes, rachis prominently flattened with the spikelets loosely imbricate. Spikelets are sessile with 3 to 15 flowers.

Eragrostis tremula(figure 1, J). Common name - Adarathana (Sri Lanka). It is a short lived grass up to 75 cm high. Panicle is widely spreading, with long pedicelled yellow-green or purplish spikelets. It is distributed throughout tropical Africa, India, Sri Lanka and Burma in low rainfall areas and used as livestock fodder.

Isachne globosa(figure 1, K). Common name - Bata dhella (Sri Lanka). It is aquatic or semi-aquatic perennial. Leaves are with ligule a rim of cilia, blade flat, wide and lightly scabrous.

Ischaemum rugosum(figure 1, L). Common names - Gojarawalu/ Gomathana/ Kudu Kedu (Sri Lanka). It is a vigorous perennial or annual (in strongly desiccating soil) tufted grass, sometimes with stilt roots, rooting at the nodes, with erect, slanting or ascending, often much branched culms. It is used as forage and suitable material for compost and mulch.

Oryza rufipogon* / *Oryza sativa f. spontanea(figure 1, M). Common name - Walgoyam (Sri Lanka). It is similar to rice plant but it has high growth rate and early shattering ability. Weedy rice is one of the most notorious weeds occurring in rice-planting areas worldwide.

Panicum maximum (figure 1, N). Common name - Ginithana (Sri Lanka). It is an extremely variable species, loosely to densely tufted, shortly rhizomatous, erect or geniculately ascending and rooting at the lower nodes. Leaf blades are linear to narrowly lanceolate. It has spread in most parts of the country including natural ecosystems, abandoned or degraded lands, forest plantations *etc.* when the growth is uncontrolled it can grow up to about 2 m in height shading out and out-competing natural or planted seedlings in forests and retarding their establishment and growth. Taller height can block the access of humans and vehicles. Its faster spread both by seeds and underground stem parts threatens natural ecosystems by replacing native plants. Cattle grazing are somewhat effective in controlling this grass not to eradicate but to keep it under control.

Panicum repens(figure 1, O). Common name - Atawra (Sri Lanka). This perennial grass spreads via its large, branching rhizomes. The rhizomes creep along the ground or float in water, forming floating mats.

Paspalum conjugatum(figure 1, P). Common name - Hathana (Sri Lanka). It is a spreading perennial grass with long creeping stolons rooting at the nodes. Culms are red-purple, ascending to erect. The leaf sheath and leaves are hairy on the margins. Inflorescence is composed of two diverging racemes. It is suitable as lawn-grass. It withstands mowing and foot wear.

Imperata cylindrical(figure 1, Q). Common name - Iluk (Sri Lanka). It is a rapidly spreading noxious perennial weed in agricultural, forest and waste lands. It is a perennial rhizomatous grass. The leaves are about 2 cm wide near the base of the plant and narrow to a sharp point at the top. The margins are finely toothed and are embedded with sharp silica crystals. Once the land is colonized by this weed its subsequent propagation takes place by stolons. It poses serious problems to many agricultural

crops and forest seedlings in plantation establishment. Propagation is by wind dispersal of seeds and by underground stem parts. Manual control is very difficult and chemical control is successful.

Chrysopogonaciculatus(figure 1, R). Common name - Thuthiri (Sri Lanka).It is a vigorous creeping grass with stout, tough rhizomes and the culms ascending to 45 cm. Inflorescence is a small panicle with numerous slender branches.

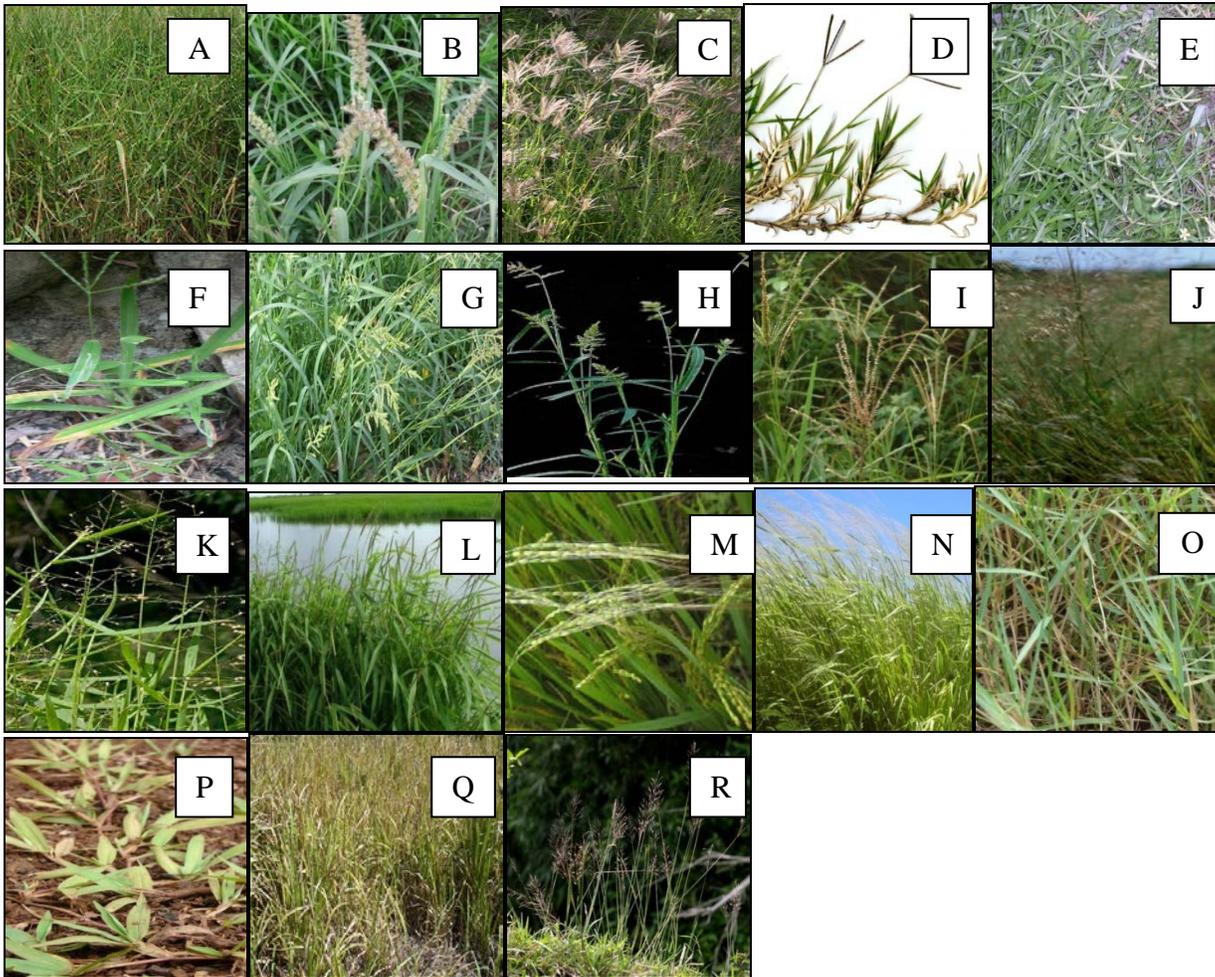


Figure 1: Major Grassweeds in Sri Lanka. A, *Brachiaria mutica*; B, *Cenchruse chinatus*; C, *Chlorish arbata*; D, *Cynodon dactylon*; E, *Dactyloctenium aegyptium*; F, *Digitaria adscendens*; G, *Echinochloa crus – galli*; H, *Echinochloa aglabrescens*; I, *Eleusine indica*; J, *Eragrostis tremula*; K, *Isachne globasa*; L, *Ischaemum rugosum*; M, *Oryza rufipogon*; N, *Panicum maximum*; O, *Panicum repens*; P, *Paspalum conjugatum*; Q, *Imperata cylindrical* and R, *Chrysopogon aciculatus*.

b) Sedges (family: Cyperaceae)

Cyperusdifformis(figure 2, A).Common names –Wellhiriya, Mottu or Bola Thunessa (Sri Lanka).It is a terrestrial, annual or perennial and tufted erect herb. Roots are fibrous and white or brown colour. Stem is triangular, solid and glabrous. Leaves are simple, not lobed or divided, alternate spiral, sessile, linear, apex acute, base clasping and parallel veined. The inflorescence is a rounded bundle one to three centimeters wide, containing up to 120 spikelets. The flowers are light brown with areas darker brown and sometimes a yellowish or purplish tint. Fruit is a nut.

Cyperushaspan(figure 2, B). Common name - Halpan (Sri Lanka).It is dwarf sedge in the Cyperaceae. Stems are tuft forming, sharply three angled, soft and weak.Leaf blades are

none, just sheaths, sheaths few, purplish and loose at base.Inflorescenceis branched having few narrow leaf like bracts.

Cyperusiria(figure 2, C).Common name -Thunessa (Sri lanka). It is a smooth, tufted sedge found worldwide. The plant often grows in rice paddies, where it is considered to be a weed. It is a terrestrial, annual or perennial and tufted herb with stolons. Roots are fibrous and white or brown. Stems are triangular, solid and hairy. Leaves are neither simple nor lobed or divided, alternate spiral, sessile, linear, more than 2 cm long/wide, glabrous or hairy, margin entire, apex acute, base clasping and parallel veined. Flowers are bisexual, grouped together into a terminal umbel, sessile, green and petals absent. Fruits are a nut.

Cyperuskyllingea(figure 2, D).Common name - Sudumottu or Mottu Thana (Sri Lanka).Its rhizome is slender, creeping, bearing stems at intervals and bracts. Leavesare long and flaccid. Nutis black. It is a weed of secondary forest and disturbed habit a weed of secondary forest and disturbed habitats.

Cyperusrotundus(figure 2, E). Common name - Kaladhuru (Sri Lanka).As in other Cyperaceae, the leaves sprout in ranks of three from the base of the plant. The flower stems have a triangular crosssection. Flower is bisexual, has three stamina and a three-stigma carpel. The fruit is a three-angled achene.The root system of a young plant initially forms white, fleshy rhizomes.

Eleocharisdulcis(figure 2, F). Common name – Boru pan (Sri Lanka). It is a grass like sedge. It is widely grown in many countries for its edible corms. It has tube shaped and leafless green stems that grow to about 1.5 metres.

Fimbristylisdichotoma(figure 2, G).Common name - MahaKudametta(Sri Lanka).Stem is tufted perennial with very short rhizome. Culms are slender to rather stout.Leaves are from much shorter than to equalling culms, scabrid on the margins. Inflorescence consists of 3-4 umbellate clusters of spikes on a peduncle. The flowers are spirally arranged. Nut is biconvex, obovoid or broad obovoid and shortly stipitate.

Fimbristylismiliacea(figure 2, H).Common name - HeenKudametta / Mudhuhul Path (Sri Lanka).It is a terrestrial, annual or perennial and tufted herb. Roots are fibrous, white or brown. Stems are erect, flat, solid, and glabrous. Flowers are bisexual, grouped together in a terminal umbel, sessile, green or brown and petals absent. Fruit is a nut.

Fimbristylistetragona(figure 2, I).Common name - HeenKokmota (Sri Lanka).It is an annuals or short-lived perennials. Rhizomes are poorly developed. Culms are densely tufted, four angled and smooth with few leaf sheaths at base. Leaves are bladeless, sheath margin brown membranous and mouth obliquely truncate. Inflorescences reduced to a single terminal spikelet, ovoid to ellipsoid, many flowered, apex obtuse to round.

Schoenoplectus grossus(figure 2, J). Common name - Thunhiriya (Sri Lanka).It is a very coarse, large, erect, glabrous and aquatic or marshy herb. Stems are triangular, Leaves are few, basal, often half as long as the stem, the leaflike bracts subtending the inflorescence. Inflorescence is corymbose. Spikeletsare very numerous, brown and ovoid. Nuts are obovoid, trigonous, dark brown or black, and shining.

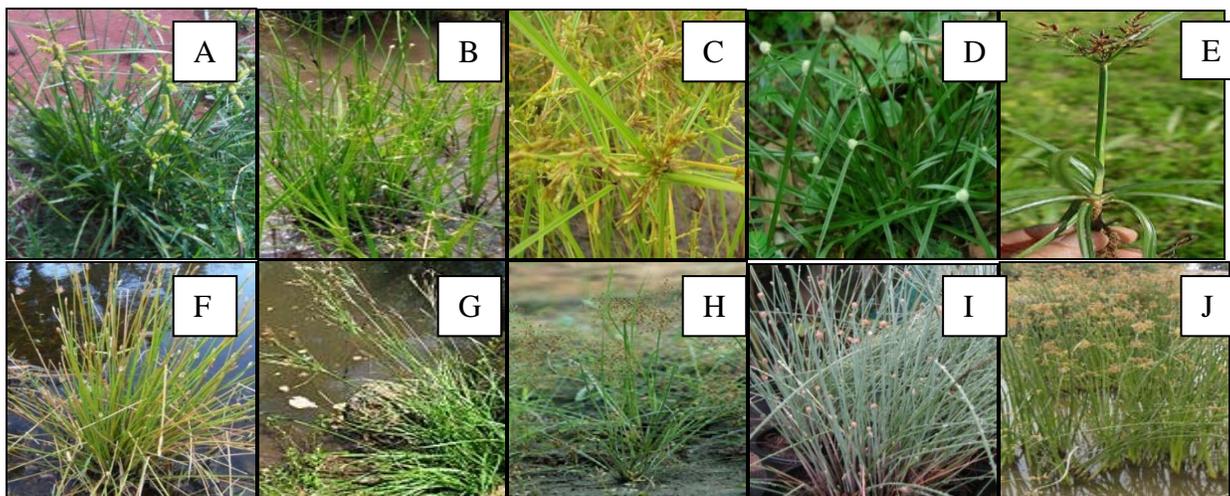


Figure 2: Major sedgeweeds in Sri Lanka. A, *Cyperus difformis*; B, *Cyperus haspan*; C, *Cyperus iria*; D, *Cyperus kyllingea*; E, *Cyperus rotundus*; F, *Eleocharis dulcis*; G, *Fimbristylis dichotoma*; H, *Fimbristylis miliacea*; I, *Fimbristylis tetragona* and J, *Schoenoplectus grossus*.

c) Broad leaves

Aeschynomene indica(figure 3, A).Common name - DiyaSiyabala: Fabaceae (Sri Lanka). It is an erect and annual (sometimes perennial) herb or sub-shrub. Stems are hollow and glabrous to moderately hispid with sometimes glandular hairs. Leaves are pinnate. Inflorescences are comprising 1-6 flowers, standard yellow or whitish, mostly lined and suffused with red outside, or purplish, wings and keel greenish white or pale yellow. Pod is linear. Seed is dark olive-black.

Ageratum conyzoids(figure 3, B). Common name– Hulanthala: Asteraceae (Sri Lanka). *Ageratum conyzoides* is an

erect, branching, soft, slightly aromatic, annual herb with shallow and fibrous roots. The stems and leaves are covered with fine white hairs; the leaves are ovate.The flowers are purple, blue, pinkish or whitewith around 30 to 50 flowers and arranged in close terminal flower-heads. The fruits are small brown one-seeded achenes fruits.

Alysicarpus vaginalis(figure 3, C). Common name – Aswenna: Fabaceae (Sri Lanka). It is a low growing annual or short-lived perennial, extremely variable in habit, leaf shape and flower colour. Stems are numerous, emanating from the rootstock, variable in hairiness, moderately branched and leafy

with single simple oval-shaped leaves on a short petiole with prominent pointed stipules. Flowers are reddish yellow or pale purple. The seeds are dark red, oval or oblong.

Amaranthus viridis(figure 3, D). Common name - Kura thampala: Amaranthaceae (Sri Lanka). This is a vigorous annual herb up to 1m high and is found in summer. Stems are generally rounded, may have some ridges, and glabrous. Mostly the inflorescence is a dense spike, often with many branches. Flowers are small and green. Flowers are generally radiating around the stem. Fruit capsules are wrinkled, indehiscent, small and brown. The fruit contains smooth and glossy seeds.

Bacopa monnieri(figure 3, E). Common name - Lunuvila: Plantaginaceae (Sri Lanka). The leaves of this plant are succulent. Leaves are oblanceolate and are arranged oppositely on the stem. The flowers are small and white, with four or five petals. Its ability to grow in water makes it a popular aquarium plant. Propagation is often achieved through cuttings. It is a perennial, creeping herb.

Boerhavia diffusa(figure 3, F). Common name - Pita sudupala: Nyctaginaceae (Sri Lanka). *Boerhaviadiffusa* is a species of flowering plant in the four o'clock family which is commonly known as punarnava, red spiderling, spreading hogweed or tarvine. It is taken in herbal medicine for pain relief and other uses. *B. diffusa* is a terrestrial, prostrate, diffusely branched annual or perennial herb. Root is stout, fusiform and woody. Stem is pale pink, base woody, swollen at nodes. Leaves are opposite, unequal, ex-stipulate. Inflorescence axillary or terminal branched cymose. Flowers are small and purple colour.

Cassia occidentalis(figure 3, G). Common name - PaniThora: Fabaceae (Sri Lanka). It is an unarmed slender upright and short-lived and annual or biennial shrub. Its once-compound leaves with pointed tips. Flowers have five yellow petals and are borne in small clusters in the upper leaf forks. Its fruit is a somewhat flattened, straight or slightly sickle-shaped. This species gives off a foul odour when damaged.

Cassia tora(figure 3, H). Common name - Pethithora: Fabaceae (Sri Lanka). The plant is an herbaceous annual foetid herb. The plant consists of alternative pinnate leaves with leaflets mostly with three opposite pairs that are obovate in shape with a rounded tip. The stems have distinct smelling foliage when young. The flowers are in pairs in axils of leaves with five petals and pale yellow in colour. *Cassia tora* yellow flowers occur in pairs with stamens of unequal length producing pods that are somewhat flattened or four angled. The seeds, roots and leaves from this plant have been shown to be very beneficial to the modern system of herbal medicines.

Celosia aslatica(figure 3, I). Common name - Wal Raja Pohottu: Amaranthaceae (Sri Lanka). A high number of seeds can be produced by each flower. The leaves are either green or bronze/maroon, depending upon the cultivar. The flower can be broken into three parts: their spikes, plumes and crests vary from one another but have standard commonalities; they are usually

brightly colored, usually red, yellow, pink, or orange, though other colors can be present.

Coccinia indica(figure 3, J). Common name - GonKekiri: Cucurbitaceae (Sri Lanka). It is annual or perennial and occasionally from a woody rootstock, climbing, hispid or scabrid and monoecious. Tendrils are simple. Leaves are entire or palmately lobed. Flowers are yellow. Fruit is fleshy, small, globose or elongate and cream coloured.

Commelina diffusa(figure 3, K). Common name - HeenGirapala: Commelinaceae (Sri Lanka). It is typically an annual herb and though it may be perennial in the tropics. It spreads diffusely, creeping along the ground, branching heavily and rooting at the nodes, obtaining stem lengths up to 1 metre. The leaf blades are relatively variable, ranging from lanceolate to ovate with proximal leaves tending to be more oblong. The leaves are sessile with a leaf sheath striped with red and covered with hispid pubescence. Inflorescence enclosing bracts green. The fruit has three locules and two valves. Seeds are brown and testa deeply reticulates.

Desmodium triflorum(figure 3, L). Common name - HeenUdupiyaliya: Fabaceae (Sri Lanka). It is prostrate perennial, multi-branching, strongly stoloniferous stems, rooting freely from stolons and lower nodes of aerial stems. Leaves are stipulate, the stipules long, tapering with hairy margins and parallel venation. Leaflets are subtended by four inconspicuous stipules, obovate, margins entire, apex slightly emarginate, reticulate venation, densely pubescent on both dorsal and ventral surface.

Eclipta prostrate(figure 3, M). Common name - Kikiridiya: Asteraceae (Sri Lanka). Stem is usually a herb but sometimes flowers and fruits as a shrub. Leaf blades are both the upper and lower surfaces clothed in white, prostrate are stiff hairs. Flowers are white in colour.

Eichornia crassipes(figure 3, N). Common name - Japan jabara: Pontederiaceae (Sri Lanka). *Eichorniacrassipes* is a large floating freshwater plant with hollow, expanded leaf stalks and roots that trail underwater in a dense mat or in long hanging strands. Stems may be in the form of short runners (stolons) or upright (erect) flowering stems. Plants generally produce leaves in basal clusters. The showy flowers have six petals that are fused at their bases into a short tube. They are purple, bluish or mauve in colour. The seeds are egg-shaped and ribbed lengthwise.

Ipomoea triloba(figure 3, O). Common name - Walthalkola: Convolvulaceae (Sri Lanka). Stem is slender vine not exceeding a stem diameter of 2 cm. Leaf blades are thin and usually with two conspicuous basal lobes. Flowers are pink white. Fruit is perianth lobes persistent at the base. Seeds are glabrous.

Leucas zeylanica(figure 3, P). Common name - Geta-tumba: Lamiaceae. (Sri Lanka). It is a small, terrestrial, herbaceous, annual, erect or sometimes tufted, and aromatic plant. Stem is green in color. Leaves occur opposite sides of the stem and large

in number. t. Roots are mainly tap root and fibrous roots. Leaves are elliptic in shape and green in color. White colour flowers are compacted in acymes.

Limnorcharis flava(figure 3, Q). Common name - Diyagova: Alismataceae (Sri Lanka). It is very large and somewhat fleshy leaves arise from the base of the plant and are borne in clusters along a short thick erect stem. The leaves are hairless and contain a milky sap. The flowers are borne in loose clusters containing 2-15 flowers at the top of long stalks. Flower has three large pale yellow petals, three overlapping green [sepals](#) and a cluster of numerous bright yellow [stamens](#) at its centre. Seeds are dark brown in colour and horseshoeshaped.

Ludwigia decurrens(figure 3, R). Common name - Diyakarabu (Sri Lanka)

It is in family Onagraceae. This species is an annual or woody perennial herb growing up to 6 feet tall. It has an erect form and a winged stem. The linear leaves are alternately arranged. The flower has four to five yellow petals.

Ludwigia octovalvis(figure 3, S). Common name - WalKarabu: Onagraceae(Sri Lanka). This plant is an erect, perennial herb with grooved stems. The yellow flowers have four petals, each with a notch at the tip. The fruits are ribbed capsules 2.5-5 cm long.

Mikania cordata(figure 3, T). Common name–Wathupalu: Asteraceae (Sri Lanka). Stem is a slender vine not exceeding a stem. Flower heads are about 3-3.5 mm long, usually with 4 flowers in each head. Flowers mildly sweet scented and white in colour.

Mimosa pudica(figure 3, U). Common name – Nidhikumba: Fabaceae (Sri Lanka). It is a creeping annual or perennial herb often grown for its curiosity value, the compound leaves fold inward and droop when touched or shaken, to defend themselves from harm and re-open a few minutes later. The stem is slender, branching, and sparsely to densely prickly, growing to a length of 1.5 m. The leaves are bipinnately compound. Pale pink or purple flower heads arise from the leaf axils in midsummer with more and more flowers as the plant gets older. The fruit consists of clusters of 2–8 pods.

Monochoria vaginalis(figure 3, V). Common name - Diyahabarala: Pontedriaceae (Sri Lanka). It is Perennial, slightly erect and fleshy. The roots are submerged under water or rooted in the mud and the rest parts are above the water surface. The leaves are heart-shaped, shiny, and with rounded bases. The flower head is clustered and composed of up to 25 flowers. The flowers are lilac or violet-blue. It is propagated by seeds or whole plant.

Ocimum sanctum(figure 3, W). Common name–Maduruthala: Lamiaceae(Sri Lanka). It is an aromatic plant native to the Indian Subcontinent. It is an erect, many branched subshrub, with hairy stems and simple opposite green or purple leaves that are strongly scented. The flowers are purplish in elongate racemes in close whorls.

Oxalis corniculata(figure 3, X). Common name - Abulabiliya: Oxalidaceae (Sri Lanka). It is a somewhat delicate appearing, low-growing, herbaceous plant. The trifoliate leaves are subdivided into three rounded leaflets and resemble a clover in shape. Some varieties have green leaves, while others, like *Oxalis corniculata* var. *atropurpurea*, have purple. The leaves have inconspicuous stipules at the base of each petiole. Flowers are small, yellow and contain five petals. The fruit is a narrow and cylindrical capsule.

Phyllanthus debilis(figure 3, Y). Common name – Pitawakka: Euphorbiaceae(Sri Lanka). It is an annual, erect succulent plant with well branched, around 40 - 50 cm height and ovate leaves alternately arranged. Leaf margin is entire. Plant has a top root system. Flower is yellowish white.

Physalis angulata(figure 3, Z). Common name–Mottu: Solanaceae (Sri Lanka). It is an erect, herbaceous, annual plant. It reproduces by seed. Its leaves are dark green and roughly oval, often with tooth shapes around the edge. The flowers are five sided and pale yellow and the yellow orange fruits.

Portulaca oleracea(figure 3, AA). Common name–Gedha: Portulacaceae (Sri Lanka). It has smooth, reddish, mostly prostrate stems and alternate leaves clustered at stem joints and ends. The yellow flowers have five regular parts and are up to 6 mm wide.

Ricinus communis(figure 3, AB). Common name–Edaru: Euphorbiaceae(Sri Lanka). The leaves are palmate with 5-11 deeply incised lobes. The stems are green to reddish-purple in color and have hollow internodes. The inflorescence has greenish yellow flowers that are borne in spikes up to 30 cm long near the tops of the stems. Female flowers are on the top half of the spike and have conspicuous red stigmas. The male flowers on the lower half of the spike have showy yellow anthers. The female flowers are followed by reddish brown.

Scoparia dulcis(figure 3, AC). Common name–Walkoththamalli: Plantaginaceae(Sri Lanka). Usually flowers and fruits as a herb but occasionally grows into a shrub about 1 m tall. *Scopariadulcis* is a species of flowering plant. Leaves are usually in whorls of three, leaf blades variable and particularly on the lower surface. Flowers are white in colour.

Sida acuta(figure 3, AD). Common name - Gas babila: Malvaceae (Sri Lanka). Stems are branched and either upright or spreading in nature. The leaves are alternately arranged along the stems and borne on short hairy stalks. These yellowish-green coloured leaves are usually elongated in shape with toothed margins and pointed tips. The yellow flowers are borne singly or in small clusters in the upper leaf forks. Fruits are wedge-shaped and topped with two sharp awns. The true seeds are inside which are smaller and reddish brown to black in colour.

Solanum americanum(figure 3, AE). Common name–Kalukammeriya: Solanaceae (Sri Lanka). It is erect or spreading herb or short-lived perennial shrub, glabrous or sparsely pubescent with simple hairs and green or the stems. Leaves are

often purplish and prickles are absent. Stems are often angled or narrowly winged. Inflorescence is short, 4–12 flowered.

Stachytarpheta indica(figure 3, AF). Common name – Balunaguta: Verbenaceae (Sri Lanka). It is an annual and herbaceous plant. Leaves are elliptic leaf consists with serrated margin and decussate leaf arrangement. Flower is purple colour.

Tribulus terrestris(figure 3, AG). Common name– Nerenji: Zygophyllaceae (Sri Lanka). It is introduced annual or perennial and prostrate. Leaves are opposite each other. Flowers are yellow with five petals and borne singly at the bases of the leaves.

Tridax procumbens(figure 3, AH). Common name - Kurunegala daisy: Asteraceae (Sri Lanka). It is a species of flowering plant. It is best known as a widespread weed and pest plant. Stems are decumbent, producing roots at the nodes which is clothed in pale hairs. Leaf is hairy, opposite, broadly lanceolate, coarsely toothed, acute or subacute and cuneate at base.

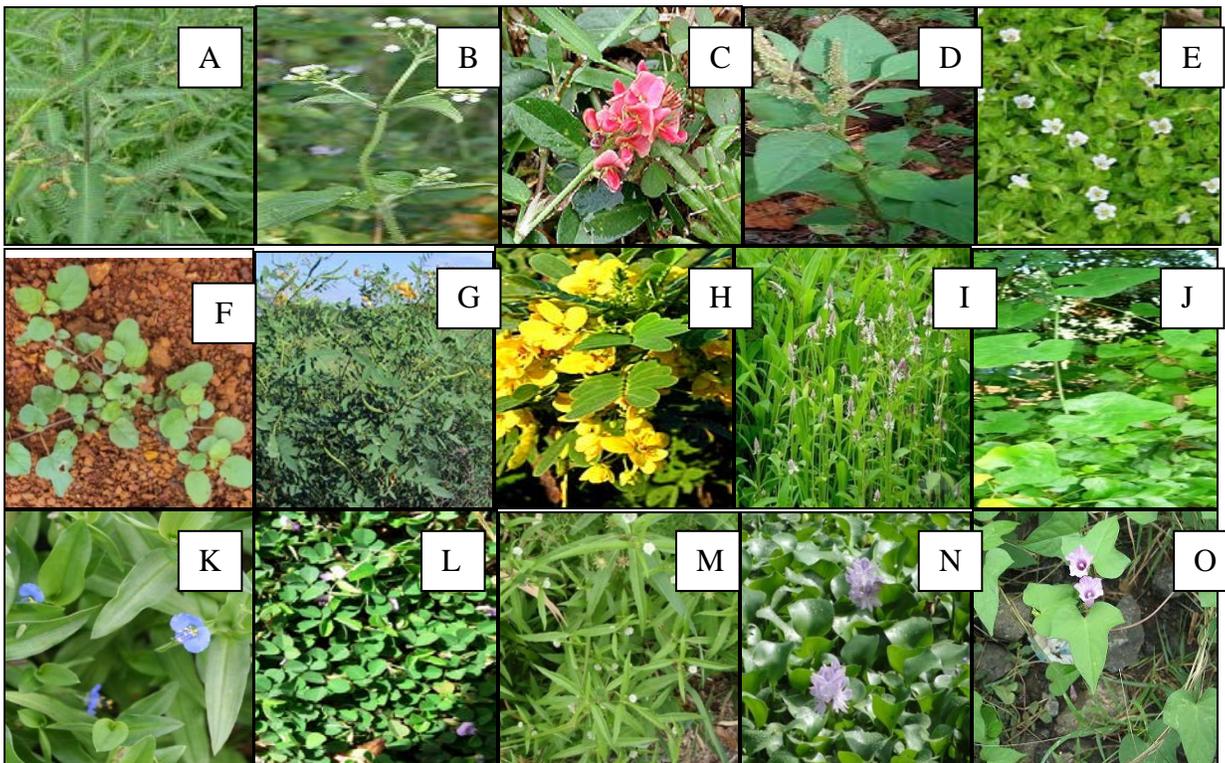
Urena lobata(figure 3, AI). Common name – Apala: Malvaceae (Sri Lanka). It is erect, woody perennial herb or small shrub. Stems and leaves are covered with stellate hairs and often many branched at the base. Leaves are simple, alternate, with the upper surface rough and the lower surface grayish, broadly

ovate. Often margins finely toothed, bases heart shaped and stipules tiny. Flowers are rose or pink, darker at the base and rounded. Fruits are small spiny capsules with 5 prominent segments.

Pistiastr atioles(figure 3, AJ). Common name - Diyaparadal: Araceae (Sri Lanka). *Pistiastratiotes* is a floating herb in rosettes of grey-green leaves, rosettes occurring singly or connected to others by short stolons. Roots are numerous and feathery. Leaves are often spongy near base, densely soft pubescen. Flowers are inconspicuous, clustered on small fleshy stalk nearly hidden in leaf axils. Fruit is arising from female flower as a many-seeded green berry.

Parthenium hysterophorus(figure 3, AK). Common name – Parthenium: Asteraceae (Si Lanka). It has pale green leaves, deeply lobed and covered with fine soft hairs. Small creamy white flowers are on stem tips. Flowers contain four to five black seeds that are wedge-shaped with two thin white scales.

Lantana camara(figure 3, AL). Common name – Gadhapana: Verbenaceae (Sri Lanka). It has rough textured and usually prickly shrub with oppositely arranged leaves. Its dense flower clusters consist of numerous small tubular flowers. The flowers can be a wide variety of colours (i.e. white, yellow, orange, red, pink or multi-coloured). Its mature fruits are glossy in appearance and black, purplish-black or bluish-black in colour.



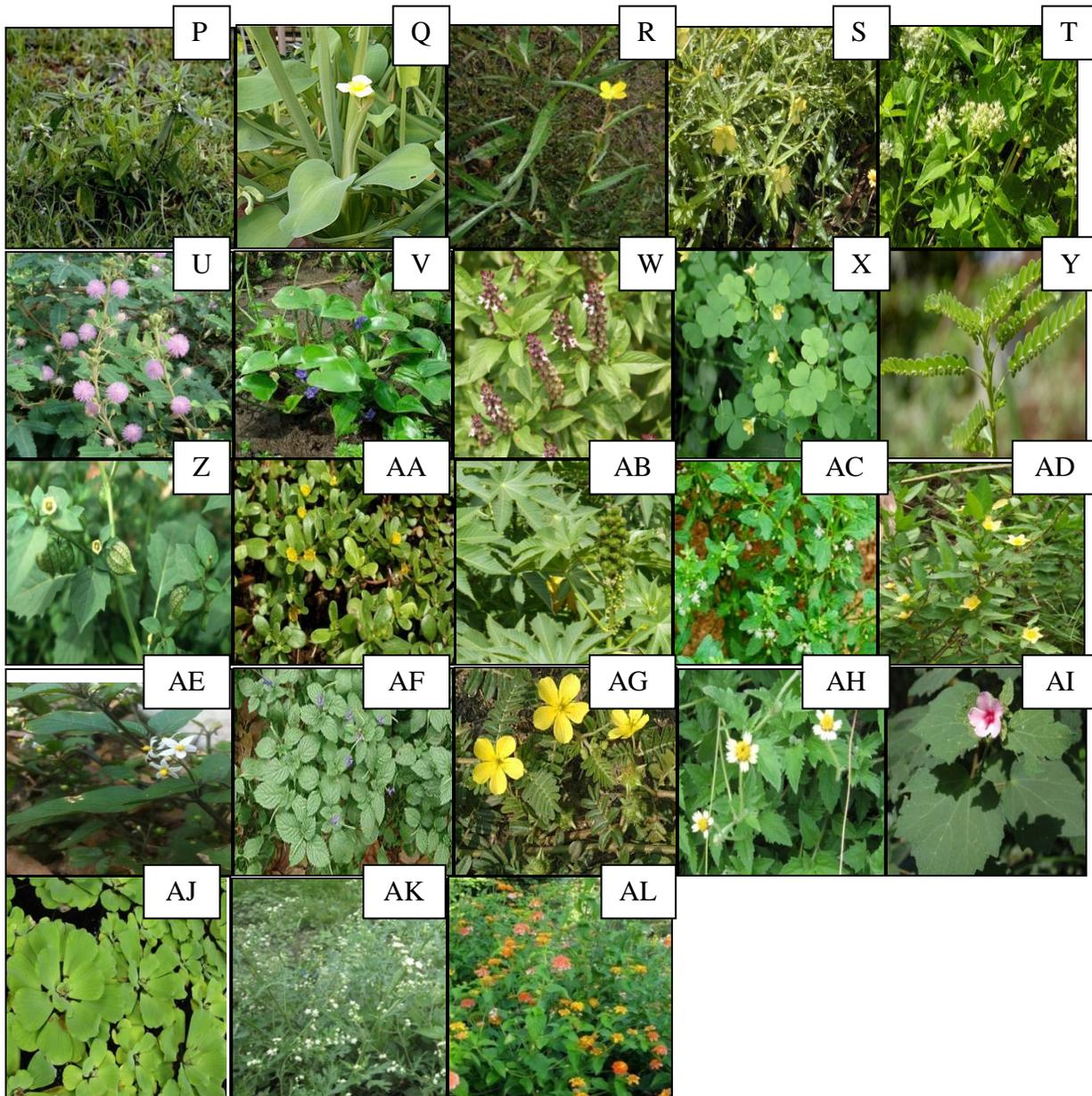


Figure 3: Major broad leaves weeds in Sri Lanka. A, *Aeschynomene indica*; B, *Ageratum conyzoids*; C, *Alysicarpus vaginalis* ;D, *Amaranthus viridis* ;E, *Bacopa monnieri*; F, *Boerhavia diffusa*; G, *Cassia occidentalis*; H, *Cassia tora*; I, *Celosia aslatica*; J, *Coccinia indica*; K, *Commelina diffusa*; L, *Desmodium triflorum*; M, *Eclipta prostrate*; N, *Eichornia crassipes*; O, *Ipomoea triloba*; P, *Leucas zeylanica*; Q, *Limnorcharis flava*; R, *Ludwigia decurrens*; S, *Ludwigia octovalvis*; T, *Mikania cordata*; U, *Mimosa pudica*; V, *Monochoriavaginalis*; W, *Ocimum sanctum*; X, *Oxalis corniculata*; Y, *Phyllanthus debilis* ; Z, *Physalis angulata*; AA, *Portulaca oleracea*; AB, *Ricinus communis*; AC, *Scoparia dulcis*; AD, *Sida acuta*; AE, *Solanum americanum*; AF, *Stachytarpheta indica*; AG, *Tribulus terrestris*; AH, *Tridax procumbens*; AI, *Urena lobata*; AJ, *Pistia stratiotes* AK, *Parthenium hysterophorus* and AL, *Lantana camara*.

d) Ferns

Salvinia molesta(figure 4, A).Common name – Salvinia (Sri Lanka)

Salvinia weed after it infested a large portion of the reservoir of the same name is an aquatic fern which belongs to family Salviniaceae. It is a free floating plant that does not attach to the soil, but instead remains buoyant on the surface of a body of water. The fronds are with a bristly surface caused by the hair-like strands that join at the end to form eggbeater shapes. They

are used to provide a waterproof covering. These fronds are produced in pairs also with a third modified root like frond that hangs in the water.

Marsilea quadrifida(figure 4, B).Common names - Pethipala/ Hatharapethi/ Dhiyaabulabiliya(Sri Lanka)

It is an aquatic fern of the family Marsileaceae. Aquatic fern is bearing four parted leaf resembling '4-leaf clover'. Leaves floating in deep water or erect in shallow water or on land.

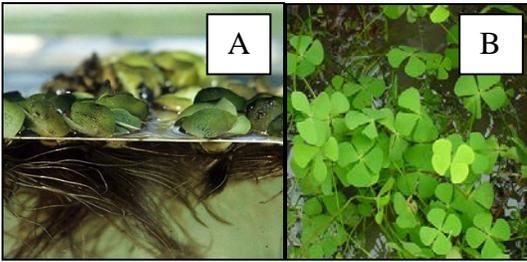


Figure 4: Major fern weeds in Sri Lanka. A, *Salvinia molesta* and B, *Marsilea quadrifida*.

III. CONCLUSION

The present study was conducted to identify the weeds of cultivated lands especially in Sri Lanka. The study helps the farmers, students, researchers and agriculturists to identify the weeds and select an appropriate strategy to manage the weeds since weeds compete with crops for resources; water, nutrients and space and finally reduce its yield quantity and quality.

REFERENCES

- [1] Cruttwell M.R.E. (2000) Successes in Biological Control of Weeds Proceedings of the X International Symposium on Biological Control of Weeds 3-4-14 July 1999, Montana State University, Bozeman, Montana, USA Neal R. Spencer [ed.]: 3-14.
- [2] Dwight D.L. and Nathan L.H. (2013) Introduction to Weeds and Herbicides The Pennsylvania State University, 328 Boucke Building, University Park, PA 16802-5901.

- [3] Rajapakse R, Chandrasena N., Marambe B. and Amarasinghe L. (2012) Planning for Effective Weed Management: Lessons From Sri Lanka. Pak. J. Weed Sci. Res., 18: 843-853.
- [4] Devasinghe D.A.U.D., Premarathne K.P. and Sangakkara U.R. (2011) Weed Management by Rice Straw Mulching in Direct Seeded Lowland Rice (*Oryza sativa* L.). Tropical Agricultural Research Vol. 22 (3): 263 – 272.
- [5] Ranwala S.M.W. and Thushari P.G.I. (2012) Current status and management options for invasive plants at the Mihintale Wildlife Sanctuary. J. Natn. Sci. Foundation Sri Lanka 40 (1):67-76.

AUTHORS

First Author – Perera, P.C.D, Department of Agricultural Biology, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka.
Second Author – Dahanayake Nilanthi, Department of Agricultural Biology, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka., Email: daha_27@yahoo.com

Ambush Marketing- A Study with Special Reference to Indian Premier League 2013

Ms. Rekha K.G

Lecturer, Govt. Law College, Thrissur, Kerala, India

Abstract- One of the early definitions of the ambush marketing was developed by (Meenaghan, 1994) and it was described as “the practice whereby another company, often a competitor, intrudes upon public attention surrounding the event, thereby deflecting attention toward themselves and away from the sponsor”. The sponsorship of any event is expensive action which requires planning and execution to get the expected financial reward. The brand or company which gets the official sponsorship contract is relieved to make its plans a reality. But the ambushers are spoiling the fun and reward of the official sponsors. They are making use of any and every opportunity to exhibit their logo and brand names within the event. The study aims to identify the technique of marketing used in popular sports events called ambush marketing. The application of the technique was visible during the popular cricket league tournament Indian Premier League during its 2013 season. The official sponsors of the tournament were beverage giant PepsiCo. An invasion of the arch rival Coca Cola was noticed. It also made Pepsi to act and take counter-measures. The research paper focuses on the application of the marketing strategy by the competitors.

Index Terms- Ambush marketing, Indian premier league, Coca-Cola, PepsiCo

I. INTRODUCTION

The term (Sandler & Shani, 1989) suggested that the first instance of ambush marketing occurred when Kodak failed to secure sponsorship rights for the 1984 Olympic Games to Fuji. Undeterred, Kodak became the sponsor of the ABC's broadcasts of those Games and the “official film” of the U.S. tracks team. If Fuji was the victim of ambush marketing in 1984, it is widely accepted that it exacted its revenge on Kodak in 1988 (Bayless, 1988)Kodak secured the worldwide category sponsorship for the 1988 Olympic Games, but Fuji aggressively promoted its sponsorship of the U.S. swimming team.

Companies involved in sub-category sponsorship have not necessarily engaged in illegal behavior. Although official sponsors may see the appearance of rivals' insignia at an event as likely to create confusion, this argument overlooks the fact that rivals have the right to promote their sponsorship associations. Disputes between Reebok, who was official apparel supplier to the US team at the 1992 Olympics, and Nike, who contracted the US track and field team to wear Nike clothing when competing, illustrate this problem. Reebok considered Nike guilty of stealing exposure and publicity they believe they had purchased when they obtained the apparel sponsorship for the entire U.S. team.

However, Nike argued they simply exploited a legitimate sponsorship opportunity open to them (Hoek, 2003).

Two general categories of ambush marketing have emerged, and both are relevant to the right of association. The first, ambush marketing by association, is the classic form of this practice, in which an ambusher seeks to create an association between itself and the event (Meenaghan, 1994), (Sandler & Shani, 1989)The second, called ambush marketing by intrusion, involves merely placing one's trademarks or other indicia in event spaces where they will be captured by television cameras, or seen by those attending the event (Bartlett, 2007).

Direct ambush marketing is an intentional use of symbols and trademarks associated with the mass event so as to give the consumers the wrong impression as to the actual sponsors of the event. Under Direct Ambush Marketing the marketer intentionally tries to claim the benefit of the event. Certain direct ambush marketing strategies are: Predatory Ambushing: The direct ambushing of a market competitor, intentionally attacking a rival's official sponsorship in an effort to gain market share, and to confuse consumers as to who is the official sponsor. Coattail Ambushing: It is an attempt by a brand to directly associate itself with a property or event by "playing up" a connection to the property/event that is legitimate but does not involve financial sponsorship/ without securing official event sponsor status. Ambushing via trademark/license infringement means intentional unauthorized use of protected intellectual property. Such properties can include the logos of teams or events, or making use of unauthorized references to tournaments, teams or athletes, words and symbols in a brand's marketing as a means of attaching itself in the eyes of consumers to a property or event. Ambushing "by degree" also known as sponsor self-ambushing: Marketing activities by an official sponsor above and beyond what has been agreed on in the sponsorship contract. Indirect ambush marketing includes Ambushing "by association", Values-based ambushing, Ambushing "by distraction", "Insurgent" ambushing, "Parallel property" ambushing and Pre-emptive Ambushing

The Indian premier league is an annual twenty 20 cricket tournament, founded in2008. The founder of the tournament is the BCCI. The tournament is held between the months of April and June. The brand value of IPL is us\$7.2 billion. The initial sponsors were DLF, which cost (Rs. 2.50 billions) US \$50 million from 2008 to 2012. PepsiCo took over in 2013 which cost PepsiCo (Rs. 396.8 million) US \$72 million for 5 years. The sponsorship agreements include a deal with motorcycle maker Hero Honda worth \$22.5-million. The global broadcasting rights are held by Sony entertainment television and Singapore based World Sports Group, which cost \$1.026 billion. The broadcasters pay US \$ 918 million for television broadcasting and US\$108

million for promotion of the tournament. Sony-WSG consortium then re-sold parts of the broadcasting rights geographically to other companies. The tournament generates income of US\$1.6 billion for BCCI. Kingfisher Airlines are exclusive umpire sponsors, which cost Rs. 1.06 billion (US \$ 17 million). IPL owns 150 seconds of air time on SetMax devoted to ads appearing on the screen which also gets covered on TV. At Rs 6 lakhs per 10 seconds, it is Rs 90 lakhs per match, a minimum of Rs 54 crore for 60 matches.

Mobile rights includes live streaming which was sold to Appalya Technologies, mobile internet opportunities sold to July Systems, Cric Zenga for mobile scorecard and SIEL for smart phone applications on a revenue sharing basis. Ground sponsorships during the strategic time out (gap in between the match) have been sold to Maxx Mobile for Rs 17-20 crore for the year. A fourth central sponsor, Karbonn Mobiles, added to the existing title sponsor DLF (Rs 200 crore for five years) and associate sponsors Hero Honda, Vodafone and Citibank, who pay around Rs 25 crore for five years each. Fifty-four per cent of this is distributed among teams. DCI Mobile Studios (A division of Dot Com Info way Limited), in conjunction with Sigma Ventures of Singapore, have jointly acquired the rights to be the exclusive Mobile Application partner and rights holder for the Indian Premier League cricket matches worldwide for the next 8 years (including the 2017 season). Recently, they have released the IPL T20 Mobile applications for iPhone, Nokia Smart phones and Blackberry devices. Soon it will be made available across all other major Mobile platforms including the Android, Windows Mobile, Palm & others

II. LITERATURE REVIEW

Sponsorship is an investment in cash or kind in an activity in return for access to the exploitable commercial and marketing potential associated with that activity.

Critics call ambush marketing “parasite marketing,” (McKelvey, 2004) claiming that companies are deliberately looking for ways to piggyback on their rivals’ sponsorship of major events despite protests from sponsors and event organizers. The ambusher that gives the impression of involvement without payment is merely serving its own narrow self-interest and, in doing so, engages in behavior that is harmful to the greater good of sport. in behavior that is harmful to the greater good of sport (Schmitz, 2005).

As per study conducted in India by (Das, 2010) Sponsors are very much benefitted from IPL marketing tactics but to some extent continuous ads are creating a negative impact upon consumer’s minds as it is one of the reasons for switches. IPL ads are in no doubt influencing consumer buying behavior but are lagging behind for achieving consumer’s loyalty, so sponsors have to consider this seriously. Consumers give more importance in purchasing of products of their favorite team rather than the brand ambassador of the team. So IPL marketers have to consider this in mind while going for selecting brand ambassador of their team or while sponsoring any team.

According to (seth, 2010) Ambush marketing cannot be seen just as a marketing jargon or a commercial irritant. It need to be recognized in law to enable parties to bring the requisite action against the one who commit the act. In India too there have been

several cases of ambush marketing especially during Indian Premier League as well as before the commencement of Common wealth Games in New Delhi.

At the same time, the value of sponsorship as an effective promotional tool is increasingly being questioned. First, there is a growing concern that the excessive sponsorship-linked marketing activities surrounding the Olympic Games led to over commercialization of the Olympics (Ettorre, 1993). Second, the increasing variety of official sponsor designations creates confusion in the minds of consumers, who consequently have difficulties in identifying sponsors (Stotlar, 1993). Third, a growing number of companies without any official designation are finding creative ways to associate themselves with the event and engage in the tactic of "ambush marketing" (Graham, 1997)

Supporters of ambush marketing, including (Schmitz, 2005) see it as smart business. Arguably, ambush marketing provides a positive free market force. By exposing to official sponsors and event organizers the true scope of exclusivity that any sponsor can reasonably expect to enjoy, ambushers in effect help quantify the true market value of Olympic sponsorship while participating in the marketing blitz in a manner they deem most cost effective for their company.

(Sheridan, 2010) has listed what he and others allege are the four most prevalent forms of ambush marketing techniques: “(1) purchasing advertising time around an event in order to associate a non-sponsoring company as a sponsor of the event; (2) negotiating with individual players or teams, who are participating in a larger sponsored event or league, to have them endorse a non-sponsoring company; (3) using event tickets in a promotional contest to tie a non-sponsoring company to that event; and (4) [aggressive] marketing [by] a non-sponsoring company around the location of an event.

According to (Sandler, 1998) the strong reaction of the study by might indicate the approach event organizers should take in creating a more objectionable environment for ambush marketing. Rather than attacking the ambushers and questioning their ethical standards, it might be more effective to concentrate on the consumers and show them they are being misled.

In some events, sponsorship rights to the event itself do not include associated media rights. As a result, some sponsors discover their rivals have obtained broadcasting rights and, in some cases, higher profiles than they themselves obtain, despite their official status. The most famous example of this is Kodak’s sponsorship of the ABC broadcasts of the 1984 Olympics, noted above (Sandler & Shani, 1989).

The IPL brand has all the four realms of experience i.e. entertainment, aesthetic, education and escapist (Singh, 2012). Approximate value created by the IPL as a brand is to be in excess of US\$ 3.2 billion (2014).

Based on Major Base Ball League matches of USA and the English Premier League football cup of UK, the business model plans to create a win-win situation. Mr. Lalit Modi, the former Chairman of IPL designed and introduced the IPL format for in 2008. Team members from national and state level cricket associations of India and top players from other cricket playing nations play in the event. A Franchise owns a team and the players are 'purchased' for a season at an auction. Each player commands a price based on his playing record and current form.

The bidding follows specific rules with a cap on the total amount that each team can spend (Kadapa, 2013)

IPL is all about experiencing the mega brand. One of the rising areas of branding and services marketing is experiential marketing. Brand or service experiences are those that engage customers in memorable ways and coordinate the marketing offer to “perform” a marketing experience. Instead of something being marketed “at” or “to” its target customer, experiential marketing aims to involve the customer in the experience by studying the “touch points,” the times and places in which the customer comes into contact with the brand and looking at ways in which the brand can interact and create engagement with its customers (Singh, 2012)

In the IPL, brand value is derived from a wider variety of reasons keeping in mind the Indian viewer’s vernacular proclivities, cricketing knowledge and celebrity influence. Accordingly, drivers of brand value in the IPL can be categorized under the heads Management Strength and On-Field Performance, Marketing Strategy, Celebrity Influence and Marquee Players and Geographical Location (2014).

III. RESEARCH PROBLEM

The concept of Ambush marketing is familiar in western countries as there are regular big international level sports events conducted in USA and Europe. The technique is new in India. The objective of the study is to identify the results of Coca Cola – PepsiCo rivalry in the lights of sponsorship of Indian Premier League 2013. The study aims to measure the benefits gained by the official sponsor from the contract and the adverse effect Coca-Cola’s ambush marketing strategy on Pepsi’s sales. The study is exploratory in nature. Various literature articles and news reports are verified to arrive at conclusion.

IV. FINDINGS AND DISCUSSIONS

The US beverage and snacks maker PepsiCo has signed an Rs 50-crore deal with Multi Screen Media, owners of SET Max channel, to become one of the two presenting sponsors of the event, and will cough up other Rs 16-18 crore to become drinks partners of all eight IPL teams except Mumbai Indians. PepsiCo had paid BCCI Rs 396 crore to buy IPL title rights for five years starting 2013 double of what previous title sponsor real estate firm DLF had paid. PepsiCo had spent a record Rs 160 crore on the T20 tournament in the year 2013 held between April 3 and May 26. PepsiCo is spending almost Rs 70 crore on top of its title sponsorship deal of the Indian premier League to bag almost all possible on-air and on-ground sponsorship and branding deals for the upcoming T20 tournament. PepsiCo has also got the official pouring rights for all the 8 teams that participated in the event.

But this did not positively affect the sales of the official sponsor positively. Year-on-year comparisons show that PepsiCo’s market share in the beverages industry in April slipped to 29.7% from 32.1% a year earlier. Coca cola used a combined marketing strategy of price reduction. Coca-Cola has gained share on the back of lowering prices of 200-ml glass bottles to Rs 8 in most markets, heavy trade discounting and aggressive push

of multi-serve packs, including the recently launched 400-ml PET bottles, 300-ml glass bottles and 500-ml PET bottles. Coca-Cola had selectively reduced prices of 200-ml glass bottles to Rs 8 last year, despite the price point being a drag on its profitability.

Coca-Cola increased its market share to 48.3% from 45.8%, they said. The data, by volume, includes shares of all beverages — aerated drinks, water and juices — they said, adding that both the beverages majors increased their overall sales. While both firms improved their market share in April over the previous month, even here, Coca-Cola grew faster. The firm has said it is working on accelerating its distribution footprint from the existing 2.2 million outlets to 2.4 million outlets by the yearend. The soft drink industry, at Rs 14,000-crore, is dominated by the two top players, with smaller ones like RC Cola and Campa Cola selling marginally in small towns.

V. CONCLUSION

There are arguments in favor of and against the concept of attaching the brand to an event which already sold sponsorship rights to the competitor. It is a matter of ethics and decision of the managers to keep the actions within ethical limits. The legal regulations are becoming stricter toward these acts, so it is advisable not to spoil the goodwill over the sales figures as goodwill will serve in long term.

REFERENCES

- [1] Bartlett, P. (2007). Ambush marketing. . *Convergence*, 3 , 31–37.
- [2] Bayless. (1988). Ambush marketing is becoming a popular event at Olympic Games. *The Wall Street Journal* February 8 .
- [3] CLEARING THE FENCE WITH BRAND VALUE. (2014, February). Retrieved march 20, 2015, from American Appraisal: www.american-appraisal.in/library/news/brand-ranking--indian-premier.htm
- [4] Das, C. (2010). “Impact of IPL Sponsorship on Consumer Buying Behavior with reference to Nagpur City.
- [5] Ettore. (1993). Ambush marketing: Heading them off at the pass. *Management Review* , 53-57.
- [6] Graham, J. P. (1997). Ambush marketing. *Sport Marketing Quarterly*, 6(1) , 10-13.
- [7] Hoek, D. C. (2003). Ambush Marketing: A Critical Review and Some Practical Advice. *Marketing Bulletin*. .
- [8] Kadapa, S. (2013). How sustainable is the strategy of the Indian Premier League-IPL?A critical review of 10 key issues that impact the IPL strategy. *International Journal of Scientific and Research Publications*, Volume 3, Issue 12, .
- [9] McKelvey, S. (2004). An Analysis of the Ongoing Global Efforts to Combat Ambush Marketing: Will Corporate Marketers “Take” the Gold in Greece? *LEGAL ASPECTS SPORT* , 191-193.
- [10] Meenaghan. (1994). Point of view: Ambush marketing - Immoral or imaginative practice? *Journal of Advertising Research*, 34 (3) , 77-88.
- [11] Sandler & Shani. (1989). Olympic Sponsorship vs “ambush” marketing: Who gets the. *Journal of Advertising Research* 29 , 9-14.
- [12] Sandler, D. S. (1998). Ambush Marketing: Is Confusion To Blame for the Flickering of the Flame?*. *Psychology & Marketing* , 367-383.
- [13] Schmitz, J. K. (2005). Ambush Marketing:The Off-Field Competition at the Olympic Games. *Northwestern Journal of Technology and Intellectual Property* VOL. 3, NO. 2 , 203-208.
- [14] Seth, R. (2010). Ambush Marketing- Need for legislation in India. *Journal of Intellectual Property rights* Vol 15 November , 455-463.

- [15] Sheridan, P. D. (2010). An Olympic Solution to Ambush Marketing: How the London Olympics Show the Way to More Effective Trademark Law. SPORTS LAW. JOURNAL , 27,28.
- [16] Singh, S. (2012). BRANDING CRICKET – THE IPL WAY. International Journal of Research in Management, Economics and Commerce Volume2, Issue 11 November , 85-91.
- [17] Stotlar, D. K. (1993). Sponsorship and the Olympic Winter Games. Sport Marketing Quarterly2(1) , 35-43.

AUTHORS

First Author – Ms. Rekha K G is a post graduate in management with specialization in Finance and Marketing. She has teaching experience of 4 years. She is a doctoral candidate and is currently working as lecturer at Government Law College in management studies department.

Fault Acknowledgement System for UPS using GSM

Aniruddha Dekate¹, Pradip Ramchaware²

Electronics And Telecommunication, Amaravti University, Akola, India

Abstract- An uninterruptible power supply, commonly called a UPS is a device that has the ability to convert and control direct current (DC) energy to alternating current (AC) energy. It uses a conventional battery of 12V rating as the input source and by the action of the inverter circuitry, it produces an alternating voltage which is sent to the load. This particular UPS is designed for a small scale load like a personal computer and hence only a basic power rate is generated by the UPS. Standard Untint eruptible Power Supply (UPS) systems are connected in series between the ac mains and the critical load. A phase controlled rectifier feeds a battery-supported dc bus and an inverter supplies the load. These systems require two conversion stages. Input power factor is poor and large harmonic currents are injected into the ac mains. The proposed model will acknowledges the person from upcoming faults and suggest its remedy via SMS. If possible apply the remedy steps and avoid the fault.

Index Terms- UPS, GSM, Controller atmega8, Fault Circuit.

I. INTRODUCTION

The industrial processes expansion become very complex the electronic systems. The costs of not planned stops are so high that a project for fault detection and fault isolation has been very important. The advances in the Information Technologies allow that one people through a mobile phone has instantaneous access to an information in practically any place of the world. This work proposes the development of a system that reduces the time where an UPS system it is remained in the period after-faults until the maintenance. In this period, depending on the fault, part of the components still is in full operation, however, if to keep them thus for a long time will be compromise all system. The developed device analyzes the behavior of the equipment and detects some types of faults. After that it transmits through one GSM link the detected fault.

II. REVIEW STAGE

In an electronics area. Firstly K. Debebe, V. Rajagopalan, T.S. Sankar proposes the use of rules based on intelligent systems to fault diagnosis in voltage-fed inverters. Through a database a mechanism makes the supposition of the system conditions, beyond the status of the protection circuit. In D. Kasta, B. K. Bose the authors had made a methodical investigation of faults modes of voltage-fed Inverter system for induction motor drives. Through this study it is possible to determine components

Problems in the steady state and to contribute for the improvement of protection systems projects.

Another work using a data-base model was considered by R. Peugeot, S. Courtine, J. Rognon. This study was based on the current vectors trajectories analysis and instantaneous frequencies during the PWM (Pulse Width Modulation) inverters faults. The fault definition was established in, like "a defect in a point or region in a circuit or component". Considering this, is possible to propose for the work definition two fault categories.

The first one where the fault leaves the equipment or device is not operate, and another one where the equipment continues operating, in inadequate form, supplying the loads. No plant stops in production systems can results of unnecessary costs, besides involving lives or important information. In hospitals or datacenters the use of UPS is essential. In this paper observe different types of fault without disturbing the UPS. An uninterruptible power supply, also uninterruptible power source, UPS or battery/flywheel backup, is an electrical apparatus that provides emergency power to a load when the input power source, typically the utility mains, fails. A UPS differs from an auxiliary or emergency power system or standby generator in that it will provide instantaneous or near instantaneous protection from input power interruptions by means of one or more attached batteries and associated electronic circuitry for low power users, and or by means of diesel generators and flywheels for high power users. The on battery runtime of most uninterruptible power sources is relatively short 5–15 minutes being typical for smaller units but sufficient to allow time to bring an auxiliary power source on line, or to properly shut down the protected equipment.

The offline / standby UPS (SPS) offers only the most basic features, providing surge protection and battery backup. The protected equipment is normally connected directly to incoming utility power. When the incoming voltage falls below a predetermined level the SPS turns on its internal DC-AC inverter circuitry, which is powered from an internal storage battery. The SPS then mechanically switches the connected equipment on to its DC-AC inverter output Frequency instability: defined as temporary changes in the mains frequency. Harmonic distortion: defined as a departure from the ideal sinusoidal waveform expected on the line. Fig-1 Offline / standby UPS

Uninterruptible power supplies (UPSS) are used to supply clean and uninterrupted power to critical loads, such as computers, communication systems, and medical support systems, etc. As such sensitive equipment is used worldwide, their interruption due to a power failure may lead to critical accidents. The UPS system is indispensable for this reason as in.

According to maintainability is the quantity mean time to repair (MTTR) that is required in viability analysis. Viability is a concept used in the architecture and engineering of digital UPS measure of a system's capability performance and reliability.

In practice and in theory, a system that cannot fail is unachievable. So therefore, it is obvious that every UPS can and will eventual fail. Hence, it remains to consider the manner and effect of those failures and the cost of minimizing them. In this paper, we identified the various manner failure occurred in UPS over five year period and the effects of those failures on MTTR.

Units
 Voltage =Volts
 Current = I
 Temperature= Degree C/ F

UPS works on voltage/current every electronic equipment bias with certain voltage with rated current. Every component dissipate some amount of heat in after biasing. This heat is sometime normal or sometime make an abnormal change in semiconductor properties, this results in system failure.

III. SYSTEM DEVELOPMENT

Working of UPS fault detection:

This is the circuit diagram of a simple UPS that can deliver 12V unregulated and 5V regulated DC. The transformer T1 steps down the mains voltage to 12V AC and then the bridge B1 rectifies it. The rectified signal is smoothed by the capacitor C1. When the mains supply is available the battery will be charged via diode D3 and the regulator IC gets supply via diode D5. 12V and 5V DC will be available at the output terminals. When mains supply is not available the battery supplies current to the regulator IC and to the 12V DC terminal through diode D4. Also, the diode D3 blocks reverse flow of current during battery mode. Capacitors C2 and C3 acts as filter.

UPS

It works on the principle of switching ie when there is an A.C power then directly feed to load. Otherwise using inverter circuit feed form battery ie 12V DC power. Initially inverters are fabricated and sold out in market but it has certain drawback. Such as

- 1) Startup time is more
- Switching time is more
- Not reliable
- Battery drain is more

In UPS this drawbacks are avoided i) Switching time is fastest ie 3Usec ii) No startup time requires MOSFET and fast switching devices are used as a switch in system.

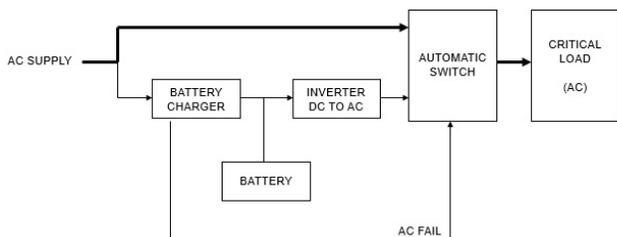


Fig 1: Block diagram of line UPS

Line interactive advantages:

Ac to dc converter / battery charger does not have to provide full load power (potentially cheaper)

Less stress on dc to ac inverter since it runs at no load until ups switches to battery power (potentially cheaper)

On-line advantages:

Zero switchover time from main line to battery power

Always isolated from power disturbances on the main line

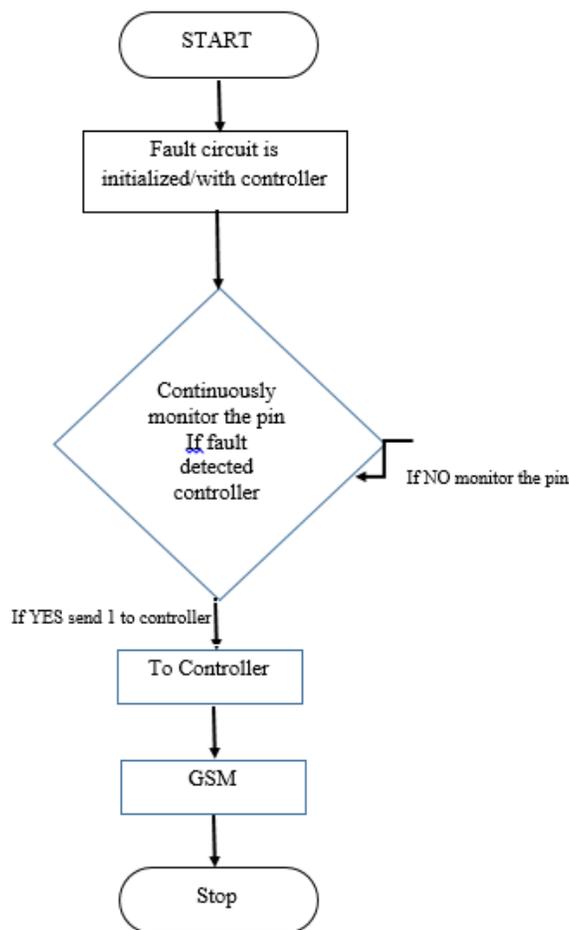


Fig: Flowchart of our proposed system

WORKING OF GSM MODULE IN UPS CIRCUIT:

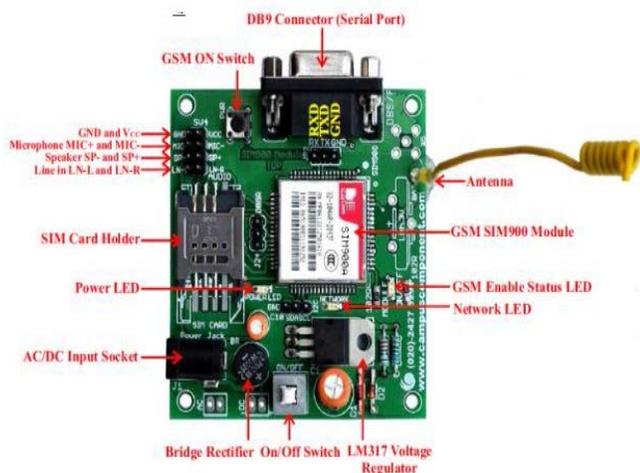


Fig 1: SIM Module

SIMCom SIM900A GSM Module:

This is actual SIM900 GSM module which is manufactured by SIMCom. Designed for global market, SIM900 is a quad-band GSM/GPRS engine that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM900 features GPRS multislots class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. With a tiny configuration of 24mm x 24mm x 3mm, SIM900 can meet almost all the space requirements in User's applications, such as M2M, smart phone, PDA and other mobile devices. We use GSM module over here for the purpose of receiving and transmitting the SMS.

Abbreviations and Acronyms

The abbreviation is as follows:

- 1>UPS- uninterruptible power supply
 - 2>GSM-global system of mobile for all
 - 3>SMS-short message service.
 - 4>SIM-subscriber identity module
- This are some of abbreviations involved in paper

Equations

As comparator is being used in circuit. Initially comparator compares the quantity with reference quantity and gives out result. For instant if voltage is being compared with reference voltage, then output is taken and change in voltage is take as a fault

$$V_o = \begin{cases} 1, & \text{if } V_+ > V_- \\ 0, & \text{if } V_+ < V_- \end{cases}$$

a comparator is a device that compares two voltages or currents and outputs a digital signal indicating which is larger. It has two analog input terminals and one binary digital output. The output is ideally a comparator consists of a specialized high-gain

differential amplifier. They are commonly used in devices that measure and digitize analog signals, such as analog-to-digital converters (ADCs), as well as relaxation oscillators.

Other Recommendations

Fault monitoring system of UPS acknowledges the person and distributes against the upcoming faults. The monitoring circuit sends SMS to user as well as dealer of UPS system.

If possible take some preventive measures to avoid that fault. For instant if temperature of system is increases the monitoring system sends SMS if preventive measures is not taken then it will switch on the integrated fan installed in the system.

If voltage is varying then system is adjust itself up to certain level then it will message to switch off the UPS system.

IV. SOME COMMON MISTAKES

The acknowledge systems are made earlier has not efficient mechanism. It will acknowledge the person after total system failure, this cause delay in online backup and installation of other system. Our proposed system will prevent the system as well it not only acknowledges the occurring faults but also takes some preventive measures to avoid it.

UPS is temperature and current sensitive device as temperature increases the semiconductor devices behavior changes result in system failure.

3.1) Advantages

- 1) remote monitoring of UPS system is possible.
- 2) Easy to detect the faults
- 3) Reliable system
- 4) Easy to maintain the battery and other system
- 5) Due to battery monitoring system it is easy to maintain battery periodically without any assistance of service engineering.
- 6) More frequent faults are avoided.
- 7) It reduce the labor charge and transportation as well

3.2) Disadvantage

- 1) GSM based system requires connectivity.
- 2) Any unit can send fault acknowledgement only
- 3) Remedies can be send but consumer have particular know how to attend the message
- 4) It is difficult to store any signal ie fault signal

3.3) Application

- 1) Desktop computers
- 2) Health monitoring units
- 3) Data centers
- 4) File servers of bank
- 5) Multi-computing system

3.3) Conclusion

The proposed circuit provides the low cost solution for fault finding and its temporary solution to customers via GSM. But as all know electronics is not easy some fault are not in our hand and not easy to handle. Our proposed circuit can bale to detect the fault but not able for recovery

We are trying to update our system as per requirement after certain successful projects. Will able us to build real time and smart electronic device. The system is universal and can be applicable to any device where current and voltages are used / applied. This system can be applicable for verity of other uses and having more advantageous to, because "prevention is better than cure".

ACKNOWLEDGMENT

We would like to take this opportunity to express my honor, respect, deep, gratitude and genuine regard to our guide Prof.

A.G.Deshmukh and our H.O.D. Prof. P.R.Pawade for giving us all guidance required for our project apart from being a constant source of inspiration and motivation. It was indeed our privilege to have worked under them.

Special Thanks to

Prof. M.V.Joshi Extc Professor in Bhonsla College of Engineering and research Akola, Maharashtra, India.

REFERENCES

- [1] "Review Paper on Fault Detection for UPS System Using GSM" by Anuradha.G.Deshmukh, Anuja B.Diggikar IJCSMC, Vol. 2, Issue. 12, December 2013, pg.344 – 349
- [2] D. Kasta, B. K. Bose, "Investigation of Fault Modes of Voltage-Fed Inverter System for Induction Motor Drive", IEEE Transactions on Industry Applications, vol. 30, n. 4, p. 1028-1038, July/August 1994.

- [3] K. Debebe, V. Rajagopalan, T.S. Sankar, "Expert Systems for Fault Diagnosis of VSI AC Drives", IEEE Industry Applications Society Annual Meeting, vol. 1, p. 368-373, 1991.
J. Breckling, Ed., The Analysis of Directional Time Series: Applications to Wind Speed and Direction, ser. Lecture Notes in Statistics. Berlin, Germany: Springer, 1989, vol. 61.
- [4] IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 56, NO. 6, JUNE 2009 1875
- [5] S. Gibilisco, The Illustrated Dictionary of Electronics, 8.ed. [s.l.] : McGraw-Hill, 2001.
- [6] Design of automatic weather station based on GSM module Author(s) Xingang Guo Dept. of Electron. & Inf. Eng., ChangChun Univ. of Technol., Changchun, China Yu Song IV. Published in: Computer, Mechatronics, Control and Electronic Engineering (CMCE), 2010 International Conference on (Volume:5) Date of Conference: 24-26 Aug. 2010

AUTHORS

First Author – Pradip Bhaskar Ramchaware electronic and telecommunication, Amaravti University, Akola, India, 09423839301, (e-mail:pradipramchaware@gamil.com).

Second Author – Anirudha A.Dekate,, electronics and telecommunication, Amaravti university, Akola, India, 09921481909.,(e-mail:aniruddha.dekate@yahoo.com)

Anirddha A Dekate student studying in B.E final year at Amaravti University, Akola, India.

Successfully completed the project on fault acknowledgement system for UPS via GSM. In our research we have developed the system which will able to detect the temperature faults, overcurrent and over voltage faults at input side as well as at output side.

An Efficient K-Means Clustering by using Combination of Additive and Multiplicative Data Perturbation for Privacy Preserving Data Mining

Bhupendra Kumar Pandya, Umesh kumar Singh, Keerti Dixit

Institute of Computer Science, Vikram University, Ujjain

Abstract- The collection of digital information by governments, corporations, and individuals has created tremendous opportunities for knowledge- and information-based decision making. Driven by mutual benefits, or by regulations that require certain data to be published, there is a demand for the exchange and publication of data among various parties. Data in its original form, however, typically contains sensitive information about individuals, and publishing such data will violate individual privacy. Privacy preserving data mining (PPDM) tends to transform original data, so that sensitive data are preserved. In this research paper we analysis CAMDP (Combination of Additive and Multiplicative Data Perturbation) technique for k-means clustering as a tool for privacy-preserving data mining. We can show that K-Means Clustering algorithm can be *efficiently* applied to the transformed data and produce *exactly the same* results as if applied to the original data.

Index Terms- CAMDP, K-means clustering.

I. INTRODUCTION

Data mining in recent years with the database and artificial intelligence developed a new technology that the big amount of raw data to discover the hidden, useful information and knowledge to help policy makers to find the potential between the data Associated factors found to be ignored. Data mining because of its huge business prospect are now becoming an international data library and information policy-making in the field of cutting-edge research, and caused extensive academic and industry relations note [1]. At present, data mining has been in business management, production control, electronic commerce, market analysis and scientific science and many other fields to explore a wide range of applications [2]. The face of huge amounts of data, the first task is to sort them out, cluster analysis is to classify the raw data as a reasonable way. The so-called clustering is a group of physical or abstract objects, according to the degree of similarity between them, divided into several groups, and makes the same data objects within a group of high similarity, and different groups of data objects are not similar [3][4]. Clustering of objects is as ancient as the human need for describing the salient characteristics of men and objects and identifying them with a type. Therefore, it embraces various scientific disciplines: from mathematics and statistics to biology and genetics. Since clustering is the grouping of similar instances/objects, some sort of measure that can determine whether two objects are similar or dissimilar is required. There

are two main type of measures used to estimate this relation: distance measures and similarity measures. Many clustering methods use distance measures to determine the similarity or dissimilarity between any pair of objects. In this paper, we analyze a new multidimensional data perturbation technique: CAMDP (Combination of Additive and Multiplicative Data Perturbation) for Privacy Preserving Data Mining that can be applied for several categories of popular data mining models with better utility preservation and privacy preservation.

II. CAMDP TECHNIQUE

The CAMDP technique is a Combination of Additive and Multiplicative Data Perturbation techniques. This Method combines the strength of the translation and distance preserving method.

2.1. Translation Based Perturbation

In TBP method, the observations of confidential attributes are perturbed using an additive noise perturbation. Here we apply the noise term applied for each confidential attribute which is constant and value can be either positive or negative.

2.2. Distance Based Perturbation

To define the distance preserving transformation, let us start with the definition of metric space. In mathematics, a metric space is a set S with a global distance function (the metric d) that, for every two points x, y in S , gives the distance between them as a nonnegative real number $d(x, y)$. Usually, we denote a metric space by a 2-tuple (S, d) . A metric space must also satisfy

1. $d(x, y) = 0$ iff $x = y$ (identity),
2. $d(x, y) = d(y, x)$ (symmetry),
3. $d(x, y) + d(y, z) \geq d(x, z)$ (triangle inequality).

2.3. Generation of Orthogonal Matrix

Many matrix decompositions involve orthogonal matrices, such as QR decomposition, SVD, spectral decomposition and polar decomposition. To generate a uniformly distributed random orthogonal matrix, we usually fill a matrix with independent Gaussian random entries, then use QR decomposition.

2.4. Data Perturbation Model

Translation and Orthogonal transformation-based data perturbation can be implemented as follows. Suppose the data owner has a private database $D_{n \times m}$, with each column of D being

a record and each row an attribute. The data owner generates a $n \times n$ noise matrix O_R , and computes

$$D'_{n \times n} = D_{n \times n} * OR_{n \times n}$$

Where $OR_{n \times n}$ is generated by Translation and Orthogonal Transformation.

The perturbed data $D'_{n \times n}$ is then released for future usage. Next we describe the privacy application scenarios where orthogonal transformation can be used to hide the data while allowing important patterns to be discovered without error.

This technique has a nice property that it preserves vector inner product and distance in Euclidean space. Therefore, any data mining algorithms that rely on inner product or Euclidean distance as a similarity criteria are invariant to this transformation. Put in other words, many data mining algorithms can be applied to the transformed data and produce exactly the same results as if applied to the original data, e.g., KNN classifier, perception learning, support vector machine, distance-based clustering and outlier detection.

III. CAMDP ALGORITHM

Algorithm: Privacy Preserving using CAMDP Technique.

Input: Original Data D .

Intermediate Result: Noise Matrix.

Output: Perturbed data stream D' .

Steps:

1. Given input data $D_{n \times n}$.
2. Generate an Orthogonal Matrix $O_{n \times n}$ from the Original Data $D_{n \times n}$.
3. Create Translation Matrix $T_{n \times n}$.
4. Create Matrix $OT_{n \times n}$ by adding the Translation Matrix $T_{n \times n}$ and Orthogonal Matrix $O_{n \times n}$.
5. Generate an Orthogonal Matrix(noise matrix) $OR_{n \times n}$ from the Matrix $OT_{n \times n}$.
6. Create Perturbed Dataset $D'_{n \times n}$ by multiplying Original Data $D_{n \times n}$ and Noise Matrix $OR_{n \times n}$.
7. Release Perturbed Data for Data Miner.
8. Stop

Comparison of Original and Perturbed Data:

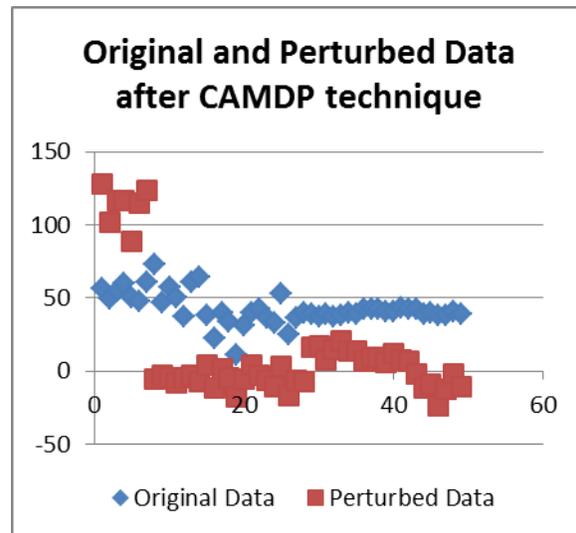


Figure 1

Euclidean Distance of Original Data

32	18.6	26.5	48.7	17.2	11	21.8
24	18.6	17.1	27.9	22.8	37	12.6
12	39.79	24.2	20.2	33.4	44	16.8

Euclidean Distance of Perturbed Data

32	18.6	26.5	48.7	17.2	11	21.8
24	18.6	17.1	27.9	22.8	37	12.6
12	39.79	24.2	20.2	33.4	44	16.8

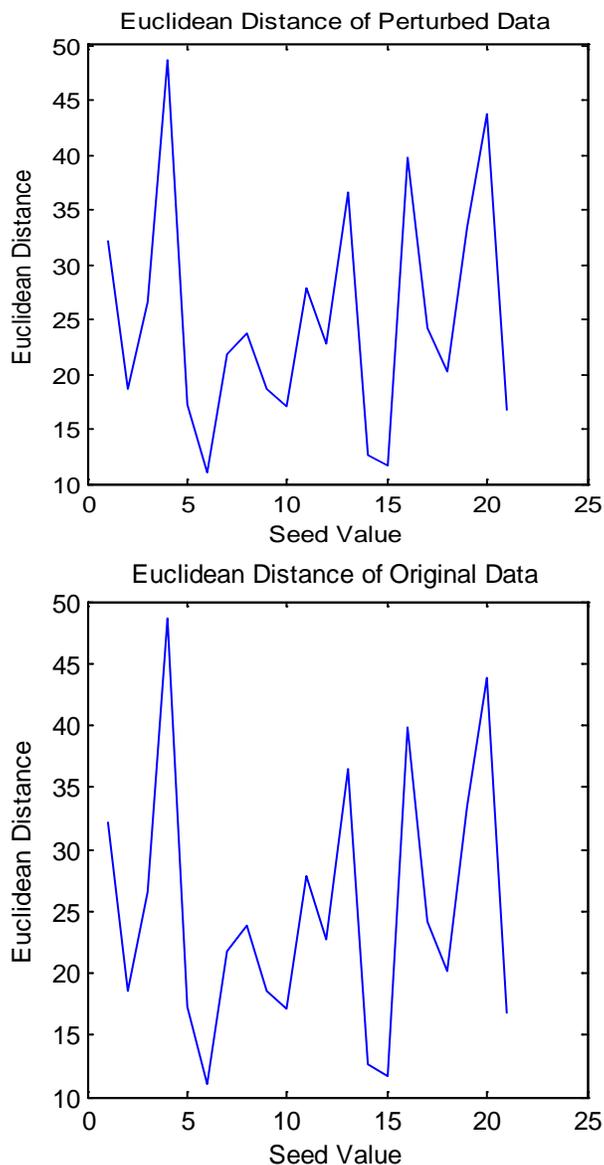


Figure 2 and 3

We have taken the original data which is result set of students. With this data we have generated a noise matrix with the help of CAMDP transformation and this resultant noise data set is multiplied with the original data set to form the perturbed data. We have plotted graph 1 that shows the difference between Original and Perturbed Data. We have evaluated Euclidean Distance of original and perturbed data with `pdist()` function of Matlab. We have plotted the graph 2 and 3 which shows the comparison between Euclidean Distances of original data and perturbed data after applying CAMDP technique.

IV. DISCUSSION

The above graph shows that the Euclidean Distance among the data records are preserved after perturbation. Hence the data perturbed by CAMDP technique can be used by various data mining applications such as k-means clustering, k_nearest neighbourhood classification, decision tree etc. And we get the same result as obtained with the original data.

V. SPECIFIC PARTITIONAL CLUSTERING TECHNIQUES: K-MEANS

The K-means algorithm discovers K (non-overlapping) clusters by finding K centroids (“central” points) and then assigning each point to the cluster associated with its nearest centroid. (A cluster centroid is typically the mean or median of the points in its cluster and “nearness” is defined by a distance or similarity function.) Ideally the centroids are chosen to minimize the total “error,” where the error for each point is given by a function that measures the discrepancy between a point and its cluster centroid, e.g., the squared distance. Note that a measure of cluster “goodness” is the error contributed by that cluster. For squared error and Euclidean distance, it can be shown [5-7] that a gradient descent approach to minimizing the squared error yields the following basic K-means algorithm.

Basic K-means Algorithm for finding K clusters.

1. Select K points as the initial centroids.
2. Assign all points to the closest centroid.
3. Recompute the centroid of each cluster.
4. Repeat steps 2 and 3 until the centroids don't change (or change very little).

K-means has a number of variations, depending on the method for selecting the initial centroids, the choice for the measure of similarity, and the way that the centroid is computed. The common practice, at least for Euclidean data, is to use the mean as the centroid and to select the initial centroids randomly.

VI. EXPERIMENTAL RESULT BASED ON THE K-MEANS CLUSTERING

We have taken the original data which is result set of students. With this data we have generated 3 clusters from the `kmeans()` function of matlab. And similarly we have generated 3 clusters by using the same function with the perturbed data. We have used silhouette function for plotting graph of the clustered data generated by the original data and also for plotting graph of the clustered data generated by perturbed data.

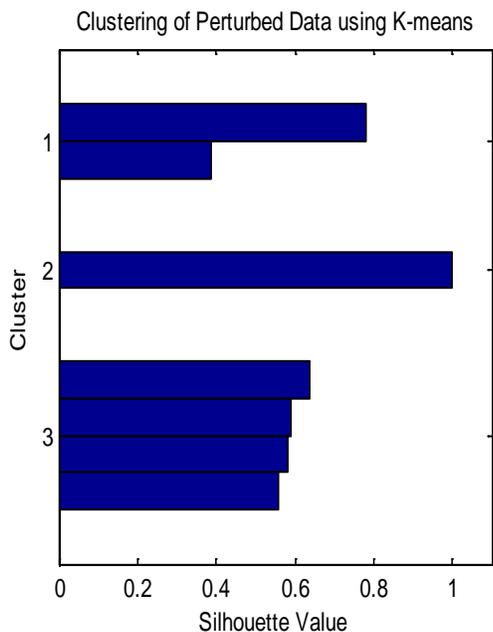
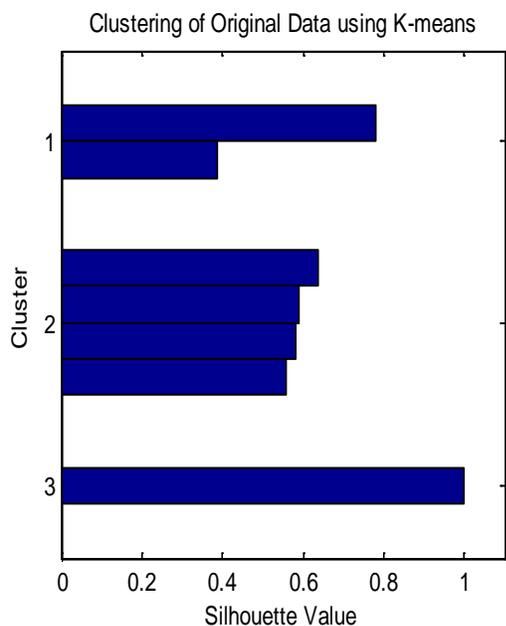


Figure 4 and 5

As depicted from the above graph it is clear that the data which shares same cluster (cluster 2) after applying the clustering on original data shares same cluster (cluster 3) after applying clustering on the perturbed data.

VII. DISCUSSION

It is proved by the experimental result that we get the same result after applying clustering to the perturbed data as after applying clustering to the original data. Hence we can say that

data perturbed by CAMDP technique can be used in clustering techniques and we can work with high dimensional data and large datasets. So we can use the perturbed data in various data mining applications like marketing, organization, land use, insurance, city planning etc.

VIII. CONCLUSION

In this research paper, we have analyzed the effectiveness of CAMDP technique. CAMDP technique includes the linear combination of Distance Preserving perturbation and translation perturbation. This technique allows many interesting data mining algorithms to be applied directly to the perturbed data and produce an error-free result, e.g., K-means clustering and K-nearest neighbor classification.

The tremendous popularity of K-means algorithm has brought to life many other extensions and modifications. Euclidean distance is an important factor in k-means clustering. In CAMDP technique the Euclidean distance is preserved after perturbation. Hence the data perturbed by this technique can be used in various clustering techniques.

REFERENCES

- [1] Strehl A, Ghosh J. Relationship-based clustering and visualization for high-dimensional data mining[J].INFORMS J COMPUT, 2003, 15(2):208-230.
- [2] Milenova B.L., Campos M.M.O-Cluster: scalable clustering of large high dimensional data sets[C].IEEE International Conference on Data Mining, 2002, 290-297.
- [3] Daniel B.A., Ping Chen Using Self-Similarity to Cluster Large Data Sets[J].Data Mining and Knowledge Discovery, 2003, 7(2):123-152.
- [4] Wei Chi-Ping, Lee Yen-Hsien, Hsu Che-Ming. Empirical comparison of fast Partitioning-based clustering algorithms for large data sets[J].Expert Systems with Applications, 2003, 24(4):351-363.
- [5] J. Han and M. Kamber. Data Mining Concepts and Techniques. Morgan Kaufmann Publishers, San Diego, CA 92101-4495, USA, 2001.
- [6] B. Pandya, U.K. Singh and K. Dixit, "Performance of Euclidean Distance Preserving Perturbation for K-Means Clustering" International Journal of Advanced Scientific and Technical Research, Vol. 5, Issue 4, pp 282-289, 2014.
- [7] B. Pandya, U.K. Singh and K. Dixit, "An Analysis of Projection Based Multiplicative Data Perturbation for K-Means Clustering" International Journal of Computer Science and Information Technologies, Vol. 5, Issue 6, pp 8067-8069, 2014.

AUTHORS

First Author – Bhupendra Kumar Pandya, Institute of Computer Science, Vikram University, Ujjain, Email: bhupendra20pandya@yahoo.co.in

Second Author – Umesh kumar Singh, Institute of Computer Science, Vikram University, Ujjain, Email: umeshsingh@rediffmail.com

Third Author – Keerti Dixit, Institute of Computer Science, Vikram University, Ujjain, Email: keerti_dixit2007@yahoo.co.in

A Meta-Analysis of Cloud Computing Infrastructures Involving Cost regulation and QoS Requirements

Gokul.M, M.Tech^{*}, J.Caroline El Fiorenza^{**}

^{*}Dept of CSE, SRM University, Ramapuram Campus, Chennai-89

^{**}Assistant Professor, Dept of CSE, SRM University, Ramapuram Campus, Chennai-89

Abstract- Cloud computing is a promising technology able to strongly modify the way computing and storage resources will be accessed in the near future. Cloud systems offer services at three different levels: infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS). In particular, IaaS clouds provide users with computational resources in the form of virtual machine (VM) instances deployed in the provider data center. PaaS and SaaS clouds offer services in terms of specific solution stacks and application software suites. Performance evaluation of Cloud Computing. An infrastructure is required to predict and quantify the cost-benefit of a strategy portfolio and the corresponding Quality of Service (QoS) experienced by users. In a market-oriented area, the cloud computing requires an accurate evaluation of these parameters is required to quantify the offered QoS and opportunely manage SLAs. There are several performance metrics have been defined, like availability, utilization, and responsiveness, allowing us to investigate the impact of different strategies on both provider and user point of views. A resiliency analysis is also provided to take into account load bursts. We can also include the analysis of autonomic techniques able to change on-the-fly the system configuration to react to a change on the working conditions. We can also extend the model to represent PaaS and SaaS cloud systems and to integrate the mechanisms needed to capture VM migration and data center consolidation aspects that cover a crucial role in energy saving policies.

Index Terms- cloud computing, resource allocation and load balancing

I. INTRODUCTION

Cloud computing is a computing paradigm in which different computing resources such as infrastructure, software applications and platform are made accessible over the internet to remote user as services. Infrastructure-as-a-Service (IaaS) clouds are becoming a rich and active branch of commercial services. Uses of IaaS clouds can provision “processing, storage, networks and other fundamental resources” on demand, and paying only for what is actually consumed. However, the increased adaption of clouds and perhaps even the pricing models depend on the ability of (perspective) cloud users to benchmark and compare commercial cloud services. The typical performance evaluation approaches in quality of service such as simulation or on-the-field measurements cannot be easily adapted. Simulation does not allow conducting comprehensive analyses of the system performance due to the great number of parameters that have to

be investigated. To implement particular resource management techniques such as VM multiplexing or VM live migration that is transparent to final user, has to be considered in the design of performance models in order to accurately understand the system behavior. Different clouds, belonging to the same or to different organizations, can join each other to achieve a common goal, represented by the optimization of resources utilization. It allows providing and releasing resources on demand thus providing elastic capabilities to the whole infrastructure. All the parameters do not conform to real time situations or exigencies and are thus reflective in nature. Field experiments are mainly focused on the QoS, they are based on a black box approach that makes difficult or correlate obtained data to the internal resource management strategies implemented by the system provider. Resource management strategies implemented by the system provider.

Cloud Model And Resources:

Clouds are modeled in the server client mode by a datacenter component for service requests handling. These requests application elements are sandboxed with VMs, which needs to be allocated processing power on data center host components. By processing, it means that a set of operations related to VM life cycle: provisioning of a host for VM creation, destruction, and migration. A Datacenter is composed by set hosts, that are responsible for managing VMs. Host is a component that represents a physical computing node in a cloud: it is assigned a pre-configured processing capability (MIPS expression is million of instruction per second), memory and storage, along with scheduling policy for allocating processing cores to VM. The Host components implement interfaces that support modeling and simulation of both single-core and multi-core nodes.

Client Requests:

Clients are registered with the server for utilizing the resources and application. Needs to access the resources and applications are implemented and customary SLA's are put in place to handle the request handling mechanisms. The Request are considered as jobs that are to be completed. A job is usage of a app or a resource or both and sending back the processed requested data. The job arrival and the request process constitute three different scenarios. In the first one (Constant arrival process) the uniform arrival process be a homogeneous Poisson process. However, in large scale distributed systems with thousands of users, like in cloud systems, could exhibit similarity or long range dependence with respect to the arrival process and in order to take into account the dependencies of the job arrival rate on both the days of a week, the hours of a day, in the second

scenario is the arrival process periodically. This model is also chosen to be the model for the job arrival process as Markov Modulated Poisson Process (MMPP).

Cloud Federation And Monitoring:

This is the analytical algorithm, where parameters like weight; intermediate requests like waiting time, bandwidth calculation completion time are all executed. This is based on the inputs the optimal solution is arrived federation with other clouds is modeled allowing tokens in place pqueue to be moved, through transition tupload, in the upload queue represented by Psend place. In accordance with the assumptions made before, transition tupload is enabled only if the number of tokens in place pqueue is greater than Q and the number of tokens in place Psend is less than D. The federated cloud availability Moreover is order to take into account, concurrent enabled transition tupload and tdrop are managed by setting their weights. For these reasons, typical performance evaluation approaches such black box approach that makes difficult to correlate obtained data to the internal resource management strategies implemented by the system provider. The analytical techniques represent a good candidate, with the help of the limited solution cost of their associated models. In order to accurately represent a cloud system, an analytical model of a cloud has to be:

- **Scalable.** To deal with very large systems composed of hundreds or thousands of resources.
- **Flexible.** Allowing us to easily implement different strategies and policies and toas simulation or on-the-field measurements cannot be easily adopted. The Simulation does not allow us to conduct comprehensive analyses of the system performance due to the great number of parameters that have to be investigated. The On-the-field experiments are mainly focused on the offered QoS; they are based on a represent different working condition.

Our goal is to perform a comprehensive investigation of the long-term variability of performance for production cloud services. Our main contribution towards this end is threefold: We collect performance traces of the largest commercial clouds. The collected traces are analyzed, revealing for each service both summary statistics and the presence or absence of performance time patterns. We evaluate through trace-based simulation the impact of the variability observed in the studied traces on three large-scale applications that are executed today or may be executed in the cloud in the (near) future: scientific computing workloads on clouds, selling virtual goods through cloud payment services and updating the virtual world status of social games through cloud-based database services.

Proposed System:

In the Proposed system we present an analytical model, based on Heuristic algorithms and stochastic reward nets (SRNs), that is both scalable to model systems composed of thousands of resources and flexible to represent different policies and cloud-specific strategies. Data stored in multiple servers when client upload the data in main server. Then we calculate the server performance and user request when client retrieve that data from

cloud. If server performance is high, client communicates with another data center. The performance of the several servers is calculated and the user request is managed periodically. The performance of the system is shown graphically by which we can visualize the performance. Due to the splitting of the workload regarding the performance, the server speed is maximum and will retrieve the files correctly.

Modules:

- Admin
- Display File
- File request
- Performance Check
- Data Download

Modules Description:

Admin

This module upload the file and checks whether the user file request is authenticated otherwise user request will neglect. This module display the user request, online users using grid view control When user login.

Display file

This module used to display all uploaded files and file details to user using grid view control. Then user select file and send request to admin for our usage.

File request

This module used to check the file request to corresponding user. And accept the valid user request. Then that file Display to user and user download that file.

Performance Check

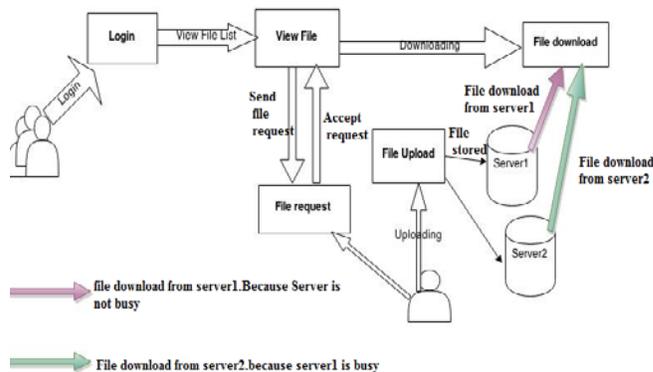
This module used to checking the performance of the system and processor. Computer performance is characterized by the amount of useful work accomplished by a computer system or computer network compared to the time and resources used.

Data Download

This module used to download the file from corresponding server. This module check user Authentication and whether user file request is accepted. Its allowed only valid user and should accept admin. valid user request. Then that file Display to user and user download that file.

Architecture Diagram:

Figure:1.1 Architecture Diagram:



II. CONCLUSION AND RESULT

The viewpoint of this project is to calculate the performance of the admin server. The Admin uploads the several files and stores in the several servers for the various access of the user operation. When the user enters into the system and tries to download the specified file from the server, they need to get access from the admin and with permission from the admin, according to the higher performance of the server, it downloads the specified file. SRNs allow us to define reward functions that can be associated to a particular state of the model in order to evaluate the performance level reached by the system during the sojourn in that state performance metrics able to characterize the system behavior from both point-of-views. the stochastic model to evaluate the performance of an IaaS cloud system. Several performance metrics have been calculated and defined, which are utilization, responsiveness and availability, allowing to investigate the impact of different strategies on both user point-of-views and provider's view. In cloud computing, an accurate evaluation of these parameters is required in order to quantify the offered QoS and opportunely manage SLAs and all the analysis are done by autonomic techniques able to change on-the fly the system configuration in order to react to change on the working conditions. This can be extended to models which represent PaaS and SaaS Cloud Systems and to integrate the mechanisms needed to capture VM migration and the data center consolidation aspects that cover a crucial role in energy saving policies. In future the model can be Implemented to include intra and reservoir clouds where other performance parameters like application takes sufficient memory and bandwidth issues are considered. This model may be replicated in web services domain where similar features are used and service agreements are made between the website client and web service provider so the concept can be extended to cover such models and issues as well in the future.

REFERENCES

- [1] R. Buyya et al., "Cloud Computing and Emerging IT Platforms: Vision, Hype, and Reality for Delivering Computing as the Fifth Utility," *Future Generation Computer System*, vol. 25, pp. 599-616, June 2009.
- [2] X. Meng et al., "Efficient Resource Provisioning in Compute Clouds via VM Multiplexing," *Proc. Seventh Int'l Conf. Autonomic Computing (ICAC '10)*, pp. 11-20, 2010.
- [3] H. Liu et al., "Live Virtual Machine Migration via Asynchronous Replication and State Synchronization," *IEEE Trans. Parallel and Distributed Systems*, vol. 22, no. 12, pp. 1986-1999, Dec. 2011.
- [4] B. Rochwerger et al., "Reservoir—When One Cloud Is Not Enough," *Computer*, vol. 44, no. 3, pp. 44-51, Mar. 2011.
- [5] R. Buyya, R. Ranjan, and R. Calheiros, "Modeling and Simulation of Scalable Cloud Computing Environments and the Cloudsim Toolkit: Challenges and Opportunities," *Proc. Int'l Conf. High Performance Computing Simulation (HPCS '09)*, pp. 1-11, June 2009.
- [6] A. Iosup, N. Yigitbasi, and D. Epema, "On the Performance Variability of Production Cloud Services," *Proc. IEEE/ACM 11th Int'l Symp. Cluster, Cloud and Grid Computing (CCGrid)*, pp. 104-113, May 2011.
- [7] V. Stantchev, "Performance Evaluation of Cloud Computing Offerings," *Proc. Third Int'l Conf. Advanced Eng. Computing and Applications in Sciences (ADVCOMP '09)*, pp. 187-192, Oct. 2009.
- [8] S. Ostermann et al., "A Performance Analysis of EC2 Cloud Computing Services for Scientific Computing," *Proc. Int'l Conf. Cloud Computing, LNCS vol. 34*, pp. 115-131, Springer, Heidelberg, 2010.

AUTHORS

First Author – Gokul.M, M.Tech, Dept of CSE, SRM University, Ramapuram campus, Chennai-89, gokulknocks@gmail.com

Second Author – J.Caroline El Fiorenza, Assistant Professor, Dept of CSE, SRM University, Ramapuram campus, Chennai-89, caro.fiorenza@gmail.com

Power of Animated Characters: A study on how pictures of animated characters on packages of packaged food & beverages influence the product liking and preferences of children and perception of parents

Prof. (Dr.) Solanki Sandip P*, Sheth Jaydeep H**

* Associate Professor, Symbiosis Institute of International Business, Symbiosis International University, Pune
** Research Scholar, Rajkot.

Abstract- India is the world's second largest producer of food next to China and has potential of being the biggest with food and agriculture sector. The Food Processing industry is the 5th largest industry in India in terms of production, consumption, export and expected growth. Among the various sectors of Food Processing industry, packaged food industry is growing at the fastest pace of 16 % p.a. There are nearly 100 international, national and local players already operating in industry and equal numbers of players are likely to enter in the market in coming years due to its huge growth potential. Packaged food products being product of low involvement category, a little differentiation exists among the products produced by various players of the industry so to differentiate their products companies make use of various marketing tools. One of the most prominent tools used in the industry is packaging. The companies make use of various packaging elements to differentiate their products. This study is undertaken to analyze the impact of animated characters provided on the packages of packaged food & beverage products on the product liking & preferences of children and on perceptions of parents. To attain the aim of study, a sample of 300 respondents was taken. The research paper is structured into five sections. The first section focuses on the introductory part of the paper. It highlights the international, national and local scenario of Food processing industry. The second section focuses on the aspects like definition of packaged food, segments of packaged food product category, importance and role of packaging in the category and main objectives of the study. The third section discusses the previous studies parallel to the current study. It also highlights how the current study is different from the previous studies. The fourth section reveals how the research has been undertaken. The last section i.e. fifth section narrates the findings of the paper, limitations of the study, policy recommendations and concluding remarks.

Index Terms- Packaged Food Products Rajkot, Animated Characters, Processed Food Industry Rajkot, Food Marketing, Children Preferences Rajkot

I. INTRODUCTION

1 International, National And Local Scenario Of Food Processing Industry:-

1.1 Global processed food industry:-

According to Food Agricultural Organization (FAO), Food processing can be defined as the process that encompasses all the steps that food goes through from the time it is harvested to the time it arrives on consumer's plate. The size of global processed food industry is estimated to be valued around at US \$ 3.6 trillion and accounts for three-fourth of the global food sales.¹ Despite its large size, only 6% of processed foods are traded across borders compared to 16% of major bulk agricultural commodities. United States of America (USA) is the single largest consumer of processed food and accounts for 31% of the global sales. This is because as countries develop, high quality and value-added processed food such as convenience food is preferred over staples, which are prevalent in less developed economies. Over 60% of total retail processed food sales in the world are accounted by U.S.A, European Union and Japan taken together. Japan is the largest food processing market in the Asian region, though India and China are catching up fast and are likely to grow more rapidly. One of the most technically advanced food-processing industries globally is Australia as the products produced are of international standards and at comparatively lower prices. The share of India in global Food processed industry stands at around 1.6 %. The Ministry of Food Processing Industries has stated in its Vision 2015 that it aims to increase India's share from current level to 3% of world processed food trade.

1.2 Indian processed food industry:-

India has the second largest arable land of 161 million hectares and has the highest acreage under irrigation. Next to China, India is the second largest food producer in the world and has potential to immerge the biggest with food and agriculture sector. The size of food industry in India is estimated to be of Rs. 13, 20,000 crores (US \$ 220 billion) by 2015 and that of processed food industry is estimated to be of Rs.6, 60,000 crores (US \$110 billion) by 2015. The food processing industry is the 5th largest industry in India in terms of production, consumption, export and expected growth. The food processing accounts for about 14% of manufacturing GDP, nearly 13% of India's exports and 6% of total industrial investment and employs about 13 million people directly and 35 million people indirectly

The main sectors of the food processing industry are given in the following table:-

Table :1 Main sectors of the Food Processing Industry

Sectors	Products
Diary	Whole Milk Powder,, Condensed milk, Ice cream, Butter, Ghee & Cheese.
Fruits & Vegetables	Beverages, Juices, Concentrates, Pulp, Slices, Frozen & Dehydrated products, Potato Wafers/
Grains & Cereals	Flour, Bakery products, Starch Glucose, Comflakes, Malted foods, Beer and Malt extracts, Vermicelli, Grain based alcohol.
Fisheries	Frozen & Canned products mainly in fresh form.
Meat & Poultry	Frozen and packed – mainly in fresh form, Egg powder.
Consumer Foods	Snacks, Namkeens, Biscuits, Alcoholic and Non alcoholic beverages.

(Source:- Ministry of food processing India, Annual Report 2013)

1.3 Food processing industry in Rajkot:-

Since 2000's and more recently the food processing sector has witnessed corporatization in big way. Rajkot is the fourth largest city in the state of Gujarat (India) after Ahmedabad, Surat and vadodara.² It is world's 22nd fastest growing city. With the amalgamation of vast rural areas Rajkot has become the 23rd largest urban agglomeration in India with population of more than 3 million as of 2012. Due to this a huge demand especially of food products has emerged. To meet the demand supply gap, there is a big rise in private food processing units. Some of the prominent private players of packaged food industry operating at national level from Rajkot include Balaji wafers (p). Ltd, Gopal Namkeen, Radhe Namkeen, Atop Namkeen etc. Besides above there are nearly 300 small and micro units already operating at the district level. Among these, Balaji wafers is competing with international players with turnover of more than Rs. 500 crores p.a.

Besides above the other general items that come under shelf stable convenience foods include milk, Atta, corn flakes, vegetable and edible oils.

Frozen convenience food include fruits & vegetables in frozen form, yogurt etc

Packaged food market is expected to be of Rs.91, 000 crores by 2015. Main types of Packaged food products include (1) Milk based products like cheese, butter, ice-cream (2) Bakery products like biscuits, cakes, buns, breads etc (3) Fruit based products like fruit juices, jams, fruit drinks etc (4) Snakes, namkeens, Potato chips, sauces etc. (5) Confectionary items like sweets, jellies, chewing gums etc.

Main factors responsible for fastest growth of packaged food products include increase in urbanization, breaking up of the traditional joint family system, desire for quality, rise in per capita income , increasing number of working women, increasing health awareness, changing lifestyles and increased level of affluence in the middle income group.

II. SECTION II

2.1 Definition of Packaged food and its various segments:-

Packaged foods can be defined as those foods that are wrapped or stored in container and could be shipped to another place without any damage or destruction. They can be eaten immediately or after adding water or other product, heating or thawing. They are usually partially prepared or completely prepared. Packaged foods are also known as convenience foods because of ease of consumption. Packaged food is wide term that encompasses the various products across the different sectors of food processing industry. In broader terms, the packaged food / convenience food could be basically classified into two categories:-

Shelf stable convenience foods are further classified as:-

- Ready to cook foods – e.g. instant mixes like cake mixes, gulab-jamun mix, falooda mix, ice cream mix etc., pasta products like noodles, macaroni, vermicelli etc.
- Ready to eat foods – e.g. breads, biscuits, buns, ice cream, chips, namkeens etc

2.2 Packaging and its importance for packaged food industry:

The package is defined as a container which holds, protects and identifies the product throughout its distribution channel (Ampuero & Vila, 2006). It has been found from the recent research that approximately 73% of the products are sold on the self service bases at the point of sale (Silayoi & Speece, 2007). This shows that important cues need to be provided to the consumers at the point of sale so that companies could differentiate their products from the competitors on one hand and could attract and persuade the consumers to buy their products on the other hand. Under these circumstances the packaging would be the most useful tool that may be available for attracting the consumers' attention. This because unlike other forms of communication which tend to be fleeting, packaging plays a crucial role not only at the point of sale, but also after the actual purchase of the product. The first moment of truth is about obtaining the customers attention and communicating the benefits of the offer. The second moment of truth is about providing the tools the customer needs to experience the benefits when using the product. The packaging is even more important for packaged and ready to eat food products this is because they belong to low involvement category. Low involvement products

are basically low priced products with little importance. E.g. impulse purchase categories like namkeens and ice-creams. In these categories, consumers tend to be driven by in-store factors and extrinsic cues (e.g. brand name, packaging etc) to help them to make their decisions as they have neither the desire nor the need to comprehensively investigate and assess all the offerings available to them. Hence to take advantage of the situation companies often make innovative use of various packaging elements like shape, size, color, labels, position of visual and verbal elements etc to differentiate their products from competitors and to attract consumers to their products. One of the most prominent technique used by companies to sell their products, like biscuits, wafers, ice-cream, chocolates etc, especially targeted to children is use of animated characters on their product packages so as to attract the children to their products since the presence of these figures helps children identify and remember the associated product (Connor, 2006).

2.3 objectives of the study:-

The main objectives of the research study are as under:-

- 1) To investigate whether pictures of video game characters on food packaging influences young children's preferences of food products
- 2) To examine whether the pictures of licensed media spokes characters on beverage packaging affects young children's liking for the beverage
- 3) To examine the perceptions of parents regarding the influence of animated characters on children's food choices and behavior.
- 4) To determine the attitude of parents towards the food products which are being targeted to children and having the pictures of animated characters on their packages.

III. SECTION III

3.1 Literature review:-

Food marketing to children is wide spread phenomenon. Various researches have been undertaken from time to time to analyze the success of various strategies that companies had already employed for selling their products to children and for finding still new strategies that could be developed and employed so as to attract still more number of children. Some of the researches that served as source of inspiration for the current study are given below:-

(Stutts & Hunnicutt, 1987) suggests focusing on children of two to seven years of age. The reason is that during this period, they become increasingly controlled by images and symbolic processes, including those from advertising, and begin to make judgments about the various products they might use in the future.

(Valkenburg & Buijzen, 2003) found from his research that brand characters are very appealing to young children because of their limited cognitive abilities. According to them, preschoolers are not able to evaluate stimuli on more than one or two dimensions and focus only on the most salient attributes. Because these young children do not understand abstract or multileveled stimuli and messages, they make their decisions based on perceptual attributes, which could be the appearance of the

product or its package. As a result, young children may simply dislike a product with strange shape or ugly picture or color and like a product because it has nice picture on the package.

(Robinson et.al, 2007) conducted an experiment to analyze the effects of fast food branding on young children's taste preferences. In study the children were asked to taste 5 pairs of identical foods and beverages in packaging from McDonald's and matched but unbranded packaging. The children were then asked to indicate if both foods tasted the same or if one tasted better. The results of the study indicated that children preferred the tastes of those foods and drinks that were packaged in packaging of McDonalds rather than those that were packed in unidentifiable or unbranded packaging. This indicated brand identity can influence young children (3-5years old) tastes perceptions.

(Philpson et.al, 2008) undertook a study to evaluate the impact of various food marketing techniques, employed by various companies, on the children in Australia. They found from the study that most popular techniques adopted by companies to sell their products were use of spokes characters, celebrity and creatures on the product packages, toy giveaways and prices for winning in contests organized by company. Among the various techniques, the most influential was use of cartoon characters on the product package. The companies were able to sell more amount products which contained pictures of cartoon characters on their packages as compared to products whose packages did not incorporate any cartoon characters.

(Roberto, Baik, Harris and Brownell, 2010) evaluated the influence of licensed characters on children's taste and snack preferences. For conducting the study forty 4-6 year old children were selected. Three food products namely graham crackers, gummy fruit snacks and carrots were selected. For each food product two packages, one with cartoon character and one without cartoon character, were presented to children and they were asked to express their preferences. The results of the study showed that children significantly preferred the taste of foods that had popular cartoon characters on the packaging, compared with the same foods without cartoon characters. The majority of the children selected food sample with licensed character on it for their snack, but the effects were weaker for carrots than for gummy fruit snacks and graham crackers.

A Study was conducted by (Lapierre, Vala & Linebarger, 2011) to investigate the impact of licensed media spokes characters on food packaging and nutrition cues effect on young children's tastes assessments of products especially cereals. Children who saw a popular media character on the box reported liking the cereal more than those who viewed a box with no character on it. Those who were told the cereal was named Healthy bites liked the taste more than children who were told it was named Sugar Bites. Character presence was particularly influential on taste assessments for participants who were told that cereal was named Sugar Bites.

3.2 What distinguishes this study from earlier studies:-

The previous studies undertaken have shown that colorful picture of animated characters on the front panel of the packages of food products like as cereals, junk foods, fruits etc can be successful in increasing the young children's attention, recognition and liking for these food products as well as in stimulating them to consume more of these products. But there was hardly any research that evaluated the impact of using the pictures of animated characters on the packages of food & beverage products like energy /fruit drink and chocolate eggs on the young children's product liking & preferences. Moreover this study will be first of its kind that evaluated the perceptions of parents as well as children at the same time. Furthermore in the previous studies conducted by other prominent researchers the participants were required to taste 2 items simultaneously (1 with familiar character packaging and 1 in blank packaging) and select the one with better liking. But however in our study children were exposed to 1 item only at a time and as result of this experimental condition the results obtained from the study would be far more accurate ones and would add confidence to the general conclusion that children prefer products with appealing characters even in the absence of forced choice situation between familiar and novel products. Besides this as per the knowledge of researchers various previous studies have been undertaken in the foreign context. This study is likely to be the first one to evaluate the impact in Indian and especially in Gujarat context.

Section IV

IV. 4.1 RESEARCH METHODOLOGY:-

- **Target population:-** Children and parents of Rajkot
- **Type of Research:-** Descriptive research. Since the aim of the study is to examine and analyze the perceptions, preferences and buying behavior of children and parents of Rajkot especially with respect to ready to eat food products.
- **Research Hypothesis:-** The hypothesis tested using the study are:-
 - **H_{null 1}:-**Young children (4-7 years old) would rate the energy /fruit drink more favorably if picture of licensed cartoon character (Chhota Bheem) was displayed on the package as compared with energy /fruit drink with no characters on its package.
 - **H_{null 2}:-** Young children (4-7 years old) would elicit more liking for those chocolate eggs whose package contained the pictures of angry birds as compared to chocolate eggs without pictures of angry birds on their package.
 - **H_{null 3} :-** Amount spent by parents to buy the packaged food & beverage items like fruit drinks and chocolate eggs with animated characters on the package is independent of the gender of parents.
- **Sampling Plan**
 - **Samples and their size :-**

- **Parents:-** 100 parents who had children of 4-7 years of age were considered for study.
- **Children:-** 200 (4- 7 years old) school going children of Rajkot were considered for the study.
- **Products selected for Study:-** Fruit / energy drinks with and without cartoon characters on their package, chocolate eggs with and without animated characters on the package.
- **Sampling Method:** - Probability random sampling method was used for study.

- **Sources of Data:-** The research study employed both secondary and primary sources of data. The details are as under:-

- **Primary sources of Data:-** Personal Interview, Mall Intercept, Observation
- **Secondary sources of Data:-** Rajkot related websites, Leading Magazines and Newspapers, Company Reports, Research papers, books.

4.2 Experiment / study procedure:-

For conducting the study mainly two products were selected. They were energy / fruit drinks and chocolate eggs. The main reason for selecting these products was that for these products, the packages with animated characters and without animated characters was directly available in the market. Both energy / fruit drinks and chocolate eggs selected for study were of very superior quality and were being manufactured by the giant and leading FMCG companies of India. Before the experiment took place, parents consent was taken. Once parents consent was obtained then the children were interviewed individually. First, children were asked for their name and age. Then the interviewer asked them what they did last weekend to make them feel more at ease. During the introduction, the interviewer emphasized that there were no right or wrong answers and that their own opinion was valued the most. A smiley board, depicting five faces that displayed increasing amounts of positive affect (1, deep frown: hate it; 5, big smile: love it), was used to help children respond to the questions. The child was asked two practice questions orally, which were designed to create diverse responses (i.e. how much he or she liked going to school or cleaning his or her room). Once it was apparent that the child understood the scale, and then the experiment was conducted formally for both the products as follows. For fruit drinks and chocolate eggs product liking and preferences were analyzed. In each experiment 100 children were considered. Out of this, 50 were exposed to product packages which had no picture of animated characters on it. The responses were noted using 5 point rating scale consisting of Smiley faces. Another 50 children were asked to rate the products whose packages had picture of animated characters on it. Again the responses were noted and results were analyzed using appropriate statistical test.

V. SECTION V

5.1 Findings of the study:-

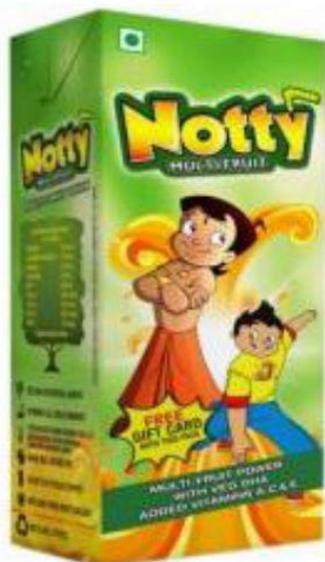
The study was undertaken in 3 phases. In 1st phase, impact of cartoon characters on children's product liking was analyzed. In 2nd phase, impact of video game characters on children's product preferences was analyzed & finally in 3rd phase the perceptions of parents were investigated. All the 3 phases have been discussed as under

Phase: 1 Analysis of how pictures of cartoon characters provided on packages of beverages influence the product preferences of children.

- For carrying out the above analysis, a sample of 100 children was taken. The products considered for study were fruit /energy drinks.
- Before starting the experiment, the age, gender and class of study of each child was noted down. It was found from the noting that out of 100 children, 59 were boys and 41 were girls. About 24 % of children were of 4 years age, 36 % of children were 5 years old, 30 % of children were 6 years old & 10 % of children were 7 years old. Nearly 56 % of children were studying in class 1, 16 % were studying in class 2 and 28 % were studying higher K.G. This information revealed that most of the children were old enough who can understand the simple questions and could respond to it easily.
- After noting the age, gender and class of study, the first formal question that was asked to children was that whether they watch television and movies or not. To this 100 % of the children replied that they watch television and movies. Then it was asked whether they watch cartoons and cartoon based movies on TV channels or not. Again 100 % of the children replied that they watch cartoons and cartoon based movies on Television
- In next step, it was asked to children that which cartoon channels they usually watch. 63 % of children replied

that they watch Cartoon Network, Pogo, Hungama. 23% replied that they also watch Disney and Nick while 14 % revealed that they watch all above channels as well as Discovery Kids. This shows that most popular channels among the kids were Cartoon Network, Pogo & Hungama.

- After gathering data about the cartoon channels, next thing that was asked to children was that which cartoons they usually watch on Cartoon channels. It was an open ended question. The aim of the question was to identify those cartoons which were popular among children and of which they are aware of. The most popular cartoons among the children were Ninja Haatori, Chhota Bheem and Mighty Raju, Tom & Jerry, Popeye, Doremon, Micky Mouse Clubhouse
- Next thing that was analyzed in Phase 1 was influence of pictures of cartoon characters, which appear on the packages of fruit / energy drinks on children's product preferences. For fulfilling the purpose, fruit /energy drinks with mix fruit flavor were selected. The cartoon character whose impact was analyzed was
- Chhota Bheem. The reason for this selection of character and product was that in supermarkets the fruit /energy drinks with and without pictures of Chhota Bheem were readily available. So direct comparison could be done easily. Now out of 100 children, 50 children were exposed to fruit /energy drink containing the picture of Chhota Bheem. It was asked to each child asked "How much did you like this fruit drink?" The responses were down using 5 point smiley based likert scale. The other 50 children were exposed to similar type of fruit / energy drink whose package had no picture of Chhota Bheem on it. Again the responses were noted down using 5 point smiley based likert scale. In each case the children rated the products just on the basis of visual imaginary of fruit drink packages they did not taste the fruit drinks at all. The pictures of fruit drinks are shown below in figure 1.



*Energy Drink with picture of
Chhota Bheem*



*Energy Drink without picture
of Chhota Bheem*

Figure 1:- Packets of fruit drinks with and without pictures of cartoon characters
(Source: - Company websites)

- Related to children's product preferences for beverages following hypothesis was developed and tested
 - **H_{null 1}** :- Young children (4-7 years old) would rate the energy /fruit drink more favorably if picture of licensed cartoon character (Chhota Bheem) was displayed on the package as compared with energy /fruit drink with no characters on its package .
 - **H_{alter 1}** :- Young children (4-7 years old) would rate the energy /fruit drink less favorably if picture of licensed cartoon character (Chhota Bheem) was displayed on the package as compared with energy /fruit drink with no characters on its package .
 - The responses of children were served as data for testing the above hypothesis. The resultant data was analyzed using the z-test of independent samples. The value of alpha was assumed to be 0.01. The analysis showed that young children of Rajkot preferred the those fruit / energy drinks whose packages contained the pictures of Chhota Bheem. Thus this showed cartoon characters had significant influence on children's product preferences especially for beverages like fruit / energy drinks.
 - Next thing that was asked to children was that whether they would think of buying this product next time when they visit to the market. In case of fruit drinks with pictures of Chhota Bheem on the package nearly 93 % of children replied that they would definitely buy these fruit drink when they will to go the market next time. In case of fruit drinks without pictures of Chhota Bheem on the package nearly 28 % of children replied that they would like to buy this fruit drink when they would go to the market next time.
 - Finally among the children who agreed to buy these specific fruit drinks, it was asked to them that how they would buy this product. To this nearly 68 % of children replied that they would go to the store with their parents and would buy this product. 23% of children replied they alone would go to store for buying these biscuits. Only 9 % of children replied that they would request to their parents to bring in the desired product.
- Phase: 2** Analysis of how pictures of animated characters of games provided on packages of ready to eat food products influences the product liking of children.
- For carrying out the above analysis, again sample of another 100 children was taken. The products selected for study were chocolate eggs.
 - Again before starting the experiment formally the age, gender and class of study of children were determined. Once the above mentioned preliminary information was obtained then it was asked to children whether they play games on TV or Computer or even on Mobiles. To this question nearly 73 % of the children replied that they play majority of games only on Mobile. About 17 % of children replied that they play games on both computer and mobile. While 10 % of children agreed that they play games on all the three media. This analysis revealed that since majority of the children play games on mobile so they would be definitely aware about the

various mobile based games as well as the specific characters of those games.

- In next step it was asked to children which games they usually play. It was an open ended question. The most popular games that usually play and like were Super Mario, Candy Crush, Battle city, GT Racing, Angry Birds, Subway Surfers & Temple Run.



Chocolate eggs without picture of angry birds

- Next thing that was analyzed in phase 2 was influence of pictures of animated characters of games that appear on packages of ready to eat food products on children's product liking. For satisfying this purpose, chocolate eggs were selected. The animated characters whose impact was analyzed were angry birds. The pictures of Chocolate eggs are shown below in figure 2



Chocolate eggs with picture of angry birds

Figure 2:- Packets of chocolate eggs with and without pictures of video game characters (Source: - Company websites)

- Now out of 100 children, 50 children were asked to rate the chocolate eggs whose package had no picture of angry birds. The children rated product just on the basis of visual imaginary of packages of chocolate eggs they did not taste the chocolate at all. The responses were noted down using 5 point smiley based likert scale. The other 50 children were exposed to similar type of chocolate egg whose package had no picture of angry birds on it.. Again their responses were noted down using 5 point smiley based likert scale. Related to children's product liking following hypothesis was developed and tested.
 - **H_{null 2}** :- Young children (4-7 years old) would elicit more liking for those chocolate eggs whose package contained the pictures of angry birds as compared to chocolate eggs without pictures of angry birds on their package.
 - **H_{alter 2}** :- Young Young children (4-7 years old) would elicit less liking for those chocolate eggs whose package contained the pictures of angry birds as compared to chocolate eggs without pictures of angry birds on their package.
- The above hypothesis was tested using z test of independent samples. The value of alpha was assumed to be 0.01. The analysis showed that young children of Rajkot significantly liked those chocolate eggs whose

package contained picture of angry birds. Hence one can conclude that pictures of animated characters of games on packages of ready to eat food products like chocolates had significant influence on children's overall liking for a product.

Phase:3 Analysis of perceptions and attitude of parents regarding the influence of pictures of animated characters that appear on the packages of packaged food and beverages on children's food choices, preferences and behavior.

- For conducting the study a sample of 100 parents, who had children of 4-6 years age, was chosen. Out of 100 parents selected 46 were male and 54 were female
- First thing that was asked to parents was whether they allow their children to watch cartoons on Television and play games on TV, mobile or computer. To this 100 % of parents replied that they allow their children to watch cartoons and play video games, if they wish.
- Next thing that was asked to parents was that whether their children's food choices were influenced by animated characters of TV or video games or not. The responses were noted using 5 point likert scale. About 58 % of parents replied that their children's food choices were significantly influenced by animated characters of TV or games. 22 % of parents replied that influence was relatively high. While 14 % replied that

influence was moderate and about 6 % replied that animated characters had no influence on their children’s food choices.

- Then it was asked to parents to describe the behavior that child exhibits for buying his / her desired food item with picture of spokes character. Nearly 36 % of parents replied that the child starts pleading over and over for buying the desired product. 22 % of parents replied that their child starts to count and pronounce the names of his/ her friends/ siblings who had bought the same product and there by starts making the requests for the same. 22 % of parents said that their child starts listing the benefits of the product and thereby makes requests for the same. 30 % parents replied that their child starts crying for buying the desired food item.
- After determining the child’s behavior it was asked to parents that how do they respond to their child’s purchase request for food item. To this 35% of parents replied that they usually allow the child to buy the desired food item. 20 % of parents said that they stop the child from buying the food item by saying that it would be unhealthy or costly. 14 % of parents said that they would say straight forward no to their child’s purchase request. 12 % of parents said that they would promise the child to buy the food item another day. While 19 % of parents said that they usually suggest alternative item in response to their child’s request.
- Next thing that was asked to parents was that why do they allow their child to buy the desired food item. To this 34% of parents said they satisfy their child’s request so as to make him /her happy.. 24 % of parents said that they satisfy their child’s request for food item so as to stop him/ her from becoming angry. 27 % said they do

so for avoiding any conflict with the child While 16 % said that they do so for preventing the child from crying.

- Next thing that was analyzed was the amount that parents would be willing to pay to buy the food item with animated characters pictures and which child requests to buy. Out of 100, 14 parents were such that who agreed to buy the food item only if its price lies within Rs. 10. 19 parents were such that who agreed to buy the food item even if its price falls within the range of Rs. 11 to 20. Nearly 15 parents were such that who agreed to buy the food item even if its price falls between Rs. 21- 30. About 12 parents agreed to buy the food item even if its price lies within the range of Rs.31 -40 while 40 parents were such that who agreed to buy the food item even if its price lies above Rs.40. Here price above 40 was considered as parents would buy the food item irrespective of price of the item.
- In relation to amount that parents would be ready to spend for buying the item that child requests the following hypothesis was developed and tested.
 - $H_{null 3}$:- Amount spent by parents to buy the packaged food & beverage items like fruit drinks and chocolate eggs with animated characters on the package is independent of the gender of parents.
 - $H_{alter 3}$:- Amount spent by parents to buy the packaged food & beverage items like fruit drinks and chocolate eggs with animated characters on the package is not independent of the gender of parents.
- The above hypothesis was tested using chi – square goodness of fit test with following contingency table. The alpha was assumed to be 0.01.

Table 2 : Contingency table for hypothesis testing

		Amount spent by parents for purchasing the food item that child requests				
		Rs. 0-10	Rs. 11 -20	Rs. 21 -30	Rs.31 -40	> Rs. 40
Gender of Parents (No. of persons)	Father	6	8	6	5	21
	Mother	8	11	9	7	19

5.2 Limitations of the study& scope of future research:-

(a)The study evaluated the impact of licensed spokes characters for two products only namely fruit drinks and chocolate eggs. But the same impact could also be evaluated for other products like cheese, corn flakes, biscuits, wafers etc whose packages also incorporate other spokes characters. (b)The select group of products spokes characters and ages sampled limit the degree to which these findings can be generalized. (c) The product-characters combinations considered in the study were readily available in the market hence any previous food or character association bias might have influenced the results obtained. (d) The characters considered in the study were popular characters but it may happen that they may not be the favorite characters of children and hence this inconsistency may have affected the

responses for products taste assessment and product liking. (e) The study evaluated the impact of only one packaging cue namely use of spokes characters but however the impact of other packaging cues like color, shape etc often used for selling products targeted to children could also be evaluated and assessed. Regardless of the above mentioned limitations the study is likely to be the first one in Indian and especially in Gujarat context to document the findings on impact of using spokes characters for selling the food products mainly targeted to children.

5.3 Policy Recommendation and Concluding remarks:-

- The study revealed that most popular cartoon channels among children were Cartoon Network, Pogo & Hungama This information suggests that if advertisers

of products targeted to children make use of these channels for advertising their products then they are likely to get their desired impact and appropriate reach for the money spent.

- The study suggests that most popular cartoons among the children were Tom & Jerry, Doremon, Chhota Bheem, Ninja Hatori, Mighty Raju and Micky Mouse. This information could work as a gem for marketers of various products. The marketers could make use of these characters for selling their products. They could use pictures of these familiar characters on the packages of their products, could provide free toys of these popular characters with their products or could launch contests and games using these familiar cartoon characters. Another advantage of this information is that marketers could advertise their products during these popular cartoon shows timings. Thus this information would provide double benefits to the marketers.
- The findings suggest that children get significantly influenced by pictures of Chhota Bheem on package of fruit drinks. This suggests that Chhota Bheem is influential character for children. So one can make use of this character selling products other than fruit drinks. The influence could be very high in case of food items.
- The majority of children revealed that they would like to buy the product along with their parents so this information suggests that companies should not try to sell the low quality and unhealthy products just by making use of attractive packaging with pictures of animated characters as there is a high probability this marketing gimmick of companies could easily get caught by the parents of the children who are going to buy the product for the children. Besides above, this information also suggests that companies should appropriately depict the product related information as that might be read by parents before buying the food products for their children.
- The analysis of study reveals that majority of children play games on mobile. Hence companies can make use of characters of those mobile games which are popular among the children for selling their products. The most classic example of such type of character is that of angry birds. The children are so much influenced by these angry birds characters that they even evaluated the entire product as best one just on seeing the picture of angry birds on the package of chocolates. The same strategy could be extended further for other products and product lines.
- The analysis revealed that amount spent by parents for buying the food item that child requests to purchase and the gender of parent are completely independent variables. This information suggests two things. First is that, one cannot presume that father would be more lenient in spending and thereby allowing the child to buy the product readily irrespective of price of the item and on the other hand one cannot also presume that mothers would be much stricter and hence less lenient in spending and thereby not allowing the child to buy the food product he /she likes. This finding is peculiar

because it contradicts the general belief that mothers would be stricter in certain spending than fathers. It may be because of mall culture or changing urban lifestyle. The two variables are completely independent. Under those circumstances the influential variables could be the nutritional healthiness of product, situation under which child is making the purchase request, no. of children accompanying the parents in the shopping trip or making purchase requests for the products etc. The second thing this information suggests that since parent's gender and amount spent for buying the item are completely independent variables so if companies make use of strategy of depicting specifically father-child or mother-child combination in the advertisement and thereby urging the children to requests the product specifically from the father or mother then that strategy may not become fruitful as both parents are equal at level in terms of spending the amount for buying the desired food item of the child.

REFERENCES

- [1] Ampuero, O., & Vila, N. (2006). Consumer perceptions of Product Packaging. *Journal of Consumer Marketing*, 23(1), pp. 100-112. Doi:- 10.1108/07363760610655032
- [2] Buijzen, M., & Valkenburg, P.M. (2003). The impact of television advertising on materialism, parent-child conflict, and unhappiness: A review research. *Journal of Applied Developmental Psychology*, 24 (1), pp. 437-456. Doi:- 10.1016/S0193-3973(03)00072-8
- [3] Connor, S.M. (2006). Food-related advertising on preschool television: building brand recognition in young viewers. *Pediatrics*, 118(4), pp. 1478 - 1485. Retrieved from: <http://www.ncbi.nlm.nih.gov/pubmed/17015538>
- [4] FICCI- KPMG (2007). Processed Food and Agribusiness: Opportunities for Investment in India. Available at: <http://www.in.kpmg.com/pdf/Processed%20Food%20%20Final.pdf>
- [5] Industries Commissionerate, Government of Gujarat (2013). Rajkot Snapshot. Available at: <http://www.vibrantgujarat.com/images/pdf/rajkot-district-profile.pdf>
- [6] Jones, S., Philipson, L., Mcvie, D., Reid, A., Lynch, M., Fabrianesi, B., & Luebcke, M., (2008). Food Marketing to Children in Australia. (Unpublished work). Department of Health and Behavioral Sciences, University of Wollongong. Retrieved from: http://www.virtualmedicalcentre.com/uploads/VMC/NewsImages/1605_Food_Marketing_to_Children_in_Australia.pdf
- [7] Lapierre, M.A., Vaala, S.E., & Linebarger, D.L. (2011). Influence of Licensed spokes characters and health cues on children's ratings of cereal taste. *Archives of Pediatrics & Adolescent Medicine*, 165(3), pp. 229-234. Doi: 10.1001/archpediatrics.2010.300
- [8] Ministry of Food Processing Industry (2013) Annual Report 2012-13. Available at: <http://www.mofpi.nic.in/>
- [9] National Skill Development Corporation report (2010). Human Resource and Skill Requirements in the Food Processing Sector: Study on mapping of Human Resource Skill Gaps in India till 2022. New Delhi, India. Available at : <http://www.nsdindia.org/pdf/food-processings.pdf>
- [10] Roberto, C.A., Baik, J., Harris, J.L., and Brownell, K.D. (2010). Influence of licensed characters on children's taste and snack preferences. *Pediatrics*, 126 (1), pp 88-93. Doi:10.1542/peds.2009-3433
- [11] Robinson, T.N., Borzekowski, D.L., Matheson, D.M., & Kraemer, H.C. (2007) Effects of Fast food branding on young children's taste preferences. *Archives of Pediatrics & Adolescent Medicine*, 161(8), pp. 792-797. Doi:10.1001/archpedi.161.8.792.
- [12] Silayoi, P., & Speece, M. (2007) The importance of packaging attributes: A conjoint analysis approach. *European Journal of Marketing*, 41 (11), pp.1495 - 1517. Doi:- 10.1108/03090560710821279

- [13] Stutts, M.A., & Hunnicutt, G. (1987). Can young children understand disclaimers in Television commercials? *Journal of Advertising*, 16 (1), pp. 41 -46. Doi:- 10.1080/00913367.1987.10673059
- [14] Technopak-Ministry of Food Processing Industry (2008). Land of opportunities : The Food Industry in India. Available at : http://cifti.org/Reports/Ficci_Technopak%20'08.pdf

Websites

- [1] <http://www.greenways-india.com/products/notty.html>
- [2] <http://www.dabur.com/Products-Foods-Juices>
- [3] <http://www.fazer.com/our-brands/fazer-angry-birds/>

AUTHORS

First Author – Prof. (Dr.) Solanki Sandip P., Associate Professor, Symbiosis Institute of International Business Symbiosis International University, Pune, E-mail: solanki@hotmail.co.in , solankisp@yahoo.com, spsolanki@hotmail.com , Mob: 076000 09029

Second Author – Sheth Jaydeep H., Research Scholar ,Rajkot. E-mail: shethjay5379@gmail.com Mob: 099256 87657

Assessment on feature Affecting Customers Bank service Variety Decision Case of United Bank, Mekelle branch

Tewelde Fisahaye Meles

Lecturer in Mekelle University – Ethiopia, MSc in Finance and investment, BED in Accounting, Mekelle University, CBE

Abstract- As economic environment is rapidly changing and customers are becoming more demanding and sophisticated, it has become important for financial institutions to determine the feature which are pertinent to the customers' selection process. Though, there are still no conditions allowing foreign banks to enter into the financial sector, particularly in banking, in creating substantial competition, domestic banks in Ethiopia will strive to provide services to their customers. This makes customers to prefer one bank than another. Hence, this paper aims to assess a feature that influences customers in selecting their banks with specific reference to united bank Mekelle branch. A cross sectional survey data in the form of both qualitative and quantitative data was used in this study. For the purpose of the study primary data was collected through field survey from customer's united bank through questionnaire consisting of both open and close ended questions. The study has identified feature such as pleasant and friendly bank staff, availability of ATM services, service quality and speed of the bank, number of branches and bank proximity as important bank selection criteria as perceived by customers. Thus banks should give proper consideration to those features to be preferable and survive in competitive markets.

Index Terms- ATM; service quality, bank selection, bank proximity

I. INTRODUCTION

Bank sectors are the largest and the most important group of financial institutions to mobilize funds effectively for the production of goods and services in any economies. Similarly, banking sector is the largest and the most important financial institutions in Ethiopia. Financial results for the 2010 fiscal year show banking industry enjoying high growth, high profits, and high dividends. Profits were up 45 percent and shareholders (at banks open for more than a year) received an average return of 27 percent on their investments (ACR, 2010).

The growth of private banks has been much faster than state-owned banks, although more than two-thirds of assets are still held by state-owned banks (Kiyota, et al., 2007). Though there are still no conditions allowing foreign banks to enter into the financial sector, particularly in banking, in creating substantial competition (Asrat, 2010); Domestic banks in Ethiopia will strive to provide services to their customers. This makes customers to prefer one bank than another. Hence, this paper aims assess feature that influence customers in selecting their banks with specific reference to United bank of Mekelle branch which is expecting to be as example for other banks. To the extent of the

knowledge of the researcher there is no research conduct with specific issues at specific bank area.

1.2 Statement of the Problem

As economic environment is rapidly changing and customers are becoming more demanding and sophisticated, it has become important for financial institutions to determine the feature which are pertinent to the customers' variety process (Boyd et al., 1994).

The competition that exists in introducing modern payment systems, ATM services, queuing windows, card services, service qualities, banks' sitting arrangement, external appearance, employees' friendliness or pleasing manner, banks' total asset, convenience, other customers recommendations presents a big challenge to the profitability of retail banking institutions of all sizes. With increasing competitiveness in the banking industry (Grady & Spencer, 1990), and similarity of services offered by banks (Holstius & Kaynak, 1995), it has become increasingly important that banks identify the feature that determine the basis upon which customers choose between providers of financial services (Almossawi, 2001).

Besides the above feasible problems in choosing appropriate banks to customers' satisfaction, there are important motivations of doing this research: First, with the advent of development and technological expansion in Ethiopia like ATM services, Card services and queuing-counter windows, which criteria are best to select banking: Second, the intention to know whether customers of one commercial banks prefer a given bank with substantial reasons or not and, Thirdly, filling the gap in shortage of literatures in the area providing substantial findings used for adjusting bank service provisions.

The specific objectives of the study are:

1. To examine the effect customers personal feature on bank variety decision
2. To assess the effect of technological feature on customer bank variety decision
3. To assess the importance of bank service quality on customer bank variety decision

II. REVIEWING LITERATURE

2.1 Overview of Banking Sector in Ethiopia

Despite a rapid increase in the number of financial institutions since financial liberalization, the Ethiopian banking system is still underdeveloped compared to the rest of the world. At the end of the fiscal year ended in June 2008, there were eleven commercial banks operating in Ethiopia, of these nine are

private commercial banks while the rest three are state owned banks (Gardachew, 2010).

The three state owned banks dominate the sector and the remaining seven are private banks. The state owned banks are Commercial bank of Ethiopia, Development bank of Ethiopia and Construction and business bank. The private banks are Dashen bank, United bank, Bank of Abyssinia, Wegagen bank, United bank, Cooperative bank of Oromia and Nib International bank. There are no foreign banks in the country, and the system remains isolated from the effects of globalization while policy-makers fear that liberalization will lead to loss of control over the economy. The government controls interest rates and fixes them under the high inflation rate.

Commercial banks in Ethiopia provide the same services with the same operational style that they used to offer before decades. The common banking functions provided by public and Determinants of customers' Bank variety decision private banks in Ethiopia are deposit mobilization, credit allocation, money transfer and safe custody. Banks in Ethiopia are unable to improve customer service, design flexible and customized products, and differentiate themselves in a market where product features are easily cloned. Ethiopian banking is unable to come from long way of being sleepy to a high proactive and dynamic entity.

The customers of Ethiopian commercial banks have missed to enjoy with the technological advancement in banking sector which has been entertained elsewhere in Africa and the rest of the world. The usage of modern e-banking methods like ATMs, Debit cards, Credit cards, Tele banking, Internet banking, Mobile banking and others are new to the Ethiopian banking sector. E-banking which refers to the use of modern technology that allows customers to access banking services electronically whether it is to withdraw cash, transfer funds, to pay bills, or to obtain commercial information and advices are not known in Ethiopia (Gardachew, 2010).

In Ethiopia it is impossible to withdraw money without presenting the pass book and money transfer as commercial banking service is allowed only in between branches of the same bank. However, from the public and the economy there is a strong need for strengthening linkages among banks in order to allow healthy flow of financial resources among financial institutions and optimize the contributions of the entire financial system to the development processes as whole.

The Ethiopian banking industry as a whole has a net work of 521 branches at the end of the fiscal period ended in June 2008, which is the lowest compared to the size of the country (1.1million square km) and number of population (78 million) and this shows that the number of population being served by a single branch stood at around 149, 712. With such highly scattered branch network and disintegrated working system it is hard to ensure efficient flow of financial resources and optimize the contributions of the entire financial system to the development processes.

2.2 Previous Studies on Customer Bank Variety Decision

Financial sectors, particularly banks, are becoming highly competitive day by day due to product differentiation, easiness of service availability, culture/religion based products offering and technology used in service delivery. Customers select banks considering various features of the service proposition. Thus, to

attract customers, banks are facing challenges more than ever. But to pull customers towards banks it is crucial to know what variety criteria customers are adopting in selecting banks

2.2.1 Personal Feature

A true professional has positive mental attitude towards life in general. He possesses strong determination and perseverance to see things through. He deals with the challenges and difficulties in job given with a sense of calmness and self control. Another important aspect is to help others and encourage them to hang on during moments of crisis.

Gender: Mokhlis, (2009) found out the relative importance attached to retail banks' choice criteria by college students in Malaysia revealed the differences in choice feature employed by male and female customers in selecting a bank for patronage.

Age: Maiyaki & Mokhtar, (2010) asserted that age group has significant influence in their choice of banks. While the older adults are more inclined towards the erstwhile "first generation banks" and the younger adults seem to prefer the new generation banks in Nigeria.

Level of education: According to Rehman & Saima (2008), higher qualification level makes bank customers more in favor of certain feature that private and privatized banks are likely to offer.

Peer influence: Syed & Guruswamy (2007) suggested that the majority of customers in Mekelle city seeking services from a retail bank make the choice based on other customers' recommendations. On the other hand, Mass media advertising and recommendation from friends and relatives were found to be less significant feature in bank variety decision (Senyucel (n.d.) & Awang, 1997). Katircioglu, Tumer, & Kilinc (2011) have also shown that Romanian people give little attention to mass media advertisement and recommendation by other people in their environment.

2.2.2 Technological feature

Many studies revealed that Customers emphasized on the importance of technology factor to select banks Availability of functional and secured ATMs all times, and connectivity to other bank's ATMs are also considered to be one of the important choice determinants While studying the switching behaviour of bank clients, availability of Technology based services is found to be a major reason for clients to switch banks. According to Senyucel (n.d.), the most important bank variety criteria for Turkish Cypriots are "availability of internet banking". These entire features imply that they do not want to spend their valuable time waiting for their turn in a queue. On the other hand, availability of electronic banking facilities such as ATM, onlineoperationand telephone banking does not have significant influence on customers' decision to choose banks (Maiyaki, & Mokhtar, 2010). Much less importance was attached to modern facilities, and drive-in service (Boyd et al., 1994).

2.2.3 Speed and Service Quality

Numerous literature reviews on previous research shows that service quality and speed is the most important factor that the consumer consider when choosing a bank of their choice. Quality of services is critical for banking sector because the products offered are mostly homogeny and hard to be differentiated.

Banks image/reputation feature

Good image of banks could be built up on creating an impression on customers. It is said that “first impression are lasting impression”.

Banks external appearance and Sitting arrangements: External appearances of bank were found to be less significant feature in bank variety decision.

Maiyaki (2011) has found out that attractiveness of banks branches tend to be less influential among the determinants of bank variety. Sitting arrangements were found to be insignificant feature.

Bank total asset: It is known that the main factor in selecting commercial banks by majority of business firms is the size of bank assets

Safety of funds: studies revealed that the safety of funds is the major reason for customers’ choice of banks. Security of deposits and security of customer information to be key reasons for choosing a particular retail bank in Mekelle city.

Secure feeling: Safety of the banking services become a concern to the customers when choosing a bank and reputation has some relation to the feel of safety by the customers. Mokhlis (2009) revealed that both male and female college students in Malaysia place more emphasis on ‘secure feeling’ suggesting that such factor should be considered seriously by the commercial banks in designing their marketing strategies. Some findings asserted that undergraduate students place more emphasis on secure feelings when choosing a bank to patronize. Others found that confidentiality of the bank for customer records are the most important feature that Romanian people give attention to choose banks. **Interest rates on deposit and loan accounts:** Things do not push out the importance of banks to provide good conveniences and technological facilities to customer but it should be done at a reasonable pricing. The pricing of services or product should be reasonable so that customers may feel that they do learn something from the relationship with the bank. However, not all researchers giving the importance of bank pricing as important in decision of choosing a banks. According to Zineldin (1996) due to banks giving unique services compare to other industry, cost and pricing is not important in this field. On the price sensitive customers, that interest rate that is too high will give negative impact on the usage rate of credits and loyalty of customers towards bank.

III. RESEARCH METHODOLOGY

3.1 Description of the Study Area

The study area has been in Mekelle city, located at northern part of Ethiopia, Tigray National Regional State. Mekelle is a special zone that is located at a distance of 783 kilometers from the capital city of Ethiopia, Addis Ababa. As per CSA projection from 2007 census, currently the zone has an estimated total population of 273,601 (131,328 are males and 142,273 females). The city has seven sub-cities with total of 18,167 business

enterprises engaged in different sector in that the wholesale and retail trade is reserved for local investors (MCTO, 2012).

3.2 Data Type and Source

A cross sectional survey data in the form of both qualitative and quantitative data was used in this study. Data from both primary and secondary sources were used. Primary data was gathered from customers of United bank in Mekelle branch using questionnaires and interview with the managers of the selected banks and Secondary data were obtained through review of annual and published reports of the previous years.

3.3 Method of Data Collection

For the purpose of the study primary data were collected through field survey from customer’s United bank through questionnaire consisting of both open and close ended questions. Primary data was also collected from manager and staff through interview. Moreover, secondary data and information were collected from annual reports, banking acts and other data on banking operations.

3.4 Sampling Design

The researcher was purposely approach the branch office of the selected bank, United bank. After that the non-probabilistic convenience sampling technique was used to select respondents. In this study respondents were selected because of their convenient accessibility at the time of data collection. Because convenience sampling is appropriate in case respondent cannot be specifically located by the researcher, but, subjects are selected because of their convenient accessibility and proximity to the researcher (Creswell, 2003). Generally, the researcher has selected the respondents (customers) who have either saving account or current account at United bank Mekelle branch. Therefore, the questionnaire were distributed to the particular customer after identifying whether they have either saving account or current account at United bank Mekelle branch.

3.5 Data Analysis Techniques

The data collected in the above mentioned way were analyzed using descriptive statistical tools such as frequency, and percentage. Besides, charts, tables and diagrams will be used to summarize and present the result.

IV. RESULT AND DISCUSSION

4.1 Respondents Profile

To investigate feature affecting customer bank variety decision questionnaire were administered and responses were collected from 50 respondents having either current or saving account. A summary of customer profile along seven variables: Gender, age, level of education, level of income and saving (average monthly income and saving of the respondent), types of employment and types of occupation has been presented in Table

4.1. Table 4.1 Respondents Profile

Variable	Categories	Respondents (N=50)	Percentage (%)
Gender	Male	32	64
	Female	18	36
Age (years)	18-25	8	16
	26-35	28	56
	36-50	8	16
	Above 50	6	12
Level of education	Below high school	7	14
	High school completed	13	26
	Diploma	12	24
	Degree	10	20
	Masters or PhD	8	16
Monthly Income	Below Br 1000	9	18
	Br 1000-3000	26	52
	Br 3000-5000	13	26
	Br 5000-10000	2	4
Monthly Saving	Below Br 1000	20	40
	Br 1000-3000	20	40
	Above Br 3000	10	20
Types of Employment	Government – sector	16	32
	Private – sector	16	32
	Self – employee	18	36
Types of bank account	Saving account	31	62
	Current account	19	38

Source: Own survey data (2015)

It has been found that the majority of the customers that is 32(64%) were males and 18 (36%) are females. Thus, in this study more proportion of male respondents were observed/surveyed. This might be due to the burden and the reproductive role women are shouldering in the household that inhabits them to access and transact at formal financial institutions which is the inherent in the developing countries.

From the total of 50 respondents, it is found that 8 (16%) having age group of Year 18-25, 28 (56%) lies in the age group of year 26-35, 8 (16%) having the age group of year 36-50, and 6 (12%) having age of above year 50. From this we can concluded that the majority of respondents are youngsters in comparison with other age groups.

All the requested customers were attended formal schooling. Among all of the respondents 7 (14%) were below high school, 13 (26%) were completed high school, 12 (24%) having diploma, 10 (20%) having degree and the remaining 8 (16%) having masters or PhD. In general all respondents were educated.

Majority of respondents that is 9 (18%) having monthly income of below Br. 1000, 26 (52%) having income of Br. 1000 – Br. 3000, 13 (26%) having monthly income of Br. 3000-Br. 5000, 2 (4%). With regard to the respondents' types of employment 16 (32%) were working in government sectors, 16 (32%) were working in private-sectors and 18 (36%) were working in their own business as self-employed customers.

4.2 Types of accounts of respondents

It is noted that majority of the respondents 31 (62%) have saving accounts and the remaining 19 (38%) are having current account.

4.3 Reasons of choosing banks, banking relationship and frequency of visiting banks

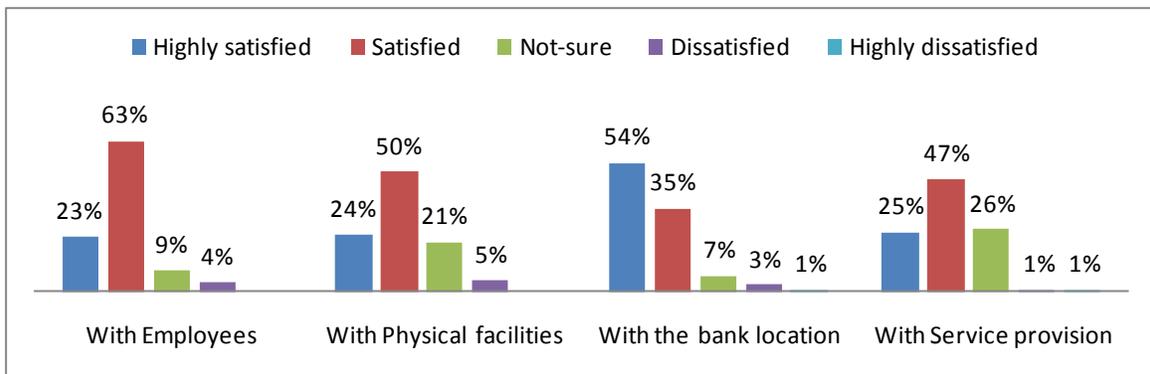
Among the respondents 39 (79%) having adequate reasons in choosing United bank and 11 (21%) of respondents having no clear and adequate reasons in selecting their banks. Among all respondents 24 (48%) were heard of good recommendations from others about their bank and 26 (52%) were not heard of anything about the bank. It is also found out that among the respondents heard of good advices 16 (32%) were from other customers, 27 (54%) were from their friends and the rest 7 (14%) were from their family or relatives. Regarding the length of banking relationship with United bank, the findings revealed that about 8(16%) of the customers had 1-year, 10 (20%) had 2-years, 8 (16%) had 3-years, 12 (24%) had 4-years, and 7 (14%) had 5-years and 5 (10%) had above 5-years previous relationship with banks. More than half of respondents 33 (66%) have visiting the bank monthly, 1 (2%) visiting daily, 12 (24%) visiting weekly and 2 (4%) visiting once in every three months.

4.4 Satisfaction with basic elements of service delivery systems

Of the four service delivery systems of banks namely, employees, physical facilities of the banks, location and service provisions of the banks majority of customers were rated their

satisfaction level on each service delivery systems at ‘satisfied’ and ‘highly satisfied’ scale in each of delivery systems. It can be depicted in the Graph below:

Figure 4.2 Satisfactions with Elements of Service Delivery Systems



4.5 Bank variety criteria of customers

Respondents have ranked the friendly or pleasing manner of bank staffs as “Very good”, “Good”, “Fairly good”, ‘Slightly good” and “Not good at all

Table 4.2 descriptive results of major bank variety criteria

Bank variety feature	Not-imp.	Slightly-Impt.	Fairly-Impt	Impt.	Very-imp.	Average
Personal Feature:						
Others’ recommendation	18 (36%)	10 (20%)	12 (24%)	5 (10%)	5(10%)	2.88
Reception at the bank	2 (4%)	2 (4%)	24 (48%)	13 (26%)	9 (18%)	3.953
Friendly/Pleasing manner of staff	2 (4%)	15 (30%)	18 (38%)	10 (20%)	5 (10%)	4.266
Technological Feature:						
Provision of ATM services	12 (24%)	8 (16%)	25 (50%)	3 (6%)	2 (4%)	1.90
Launching other modern card services	6 (12%)	10 (20%)	15 (30%)	19 (38%)	-	1.80
Numbers of counter-windows	10 (20%)	16 (32%)	17 (34%)	2 (4%)	5 (10%)	2.181
Speed and Service Quality:						
Service speed	-	14(28%)	17 (34%)	17 (34%)	9 (18%)	4.513
Service quality	1 (2%)	10 (20%)	18 (36%)	8 (16%)	3(6%)	4.553
Bank image and Reputation:						
External appearance of the bank	3 (6%)	21 (42%)	15 (30%)	6 (12%)	4 (8%)	3.06
Sitting arrangement of the bank	20(40%)	22 (44%)	5 (10%)	-	3(6%)	3.76
Bank’s total asset	35 (70%)	6 (12%)	1 (2%)	4 (8%)	4 (8%)	2.886
Safety of the bank	14 (28%)	15(30%)	10 (20%)	6 (12%)	5 (10%)	3.88
Secure feeling	2 (4%)	15 (30%)	-	27 (54%)	6 (12%)	4.233
Interest rate of the bank	17 (34%)	5 (10%)	2 (4%)	18 (36%)	8 (16%)	3.80
Convenience Feature:						
Number of branches	5 (10%)	5 (10%)	21 (42%)	14 (28%)	5 (10%)	3.926
Bank proximity	-	2 (4%)	12 (24%)	32 (64%)	4(8%)	4.586

Source: own survey (2015)

From the table above, friendly or pleasing manners of staffs, bank receptions, and service quality, secure feeling at the bank, and numbers of branches were the first five most important bank variety criteria. Most respondents, 46 (92%) replied that good reception at their bank was the variety criteria and 33 (66%) have replied that pleasant and friendly bank staff as the main criteria to select their bank. Hence from personal feature affecting bank variety decision it is observed that most of the respondent's preference for their bank is due to cheerful and hospitable manner in bank employees than being recommended by others.

With regard to the effect of technological feature, majority of the respondents 25(50%) indicated that availability of ATM services is fairly important for their bank variety criteria and most respondents 19 (38%) considered that provisions of other modern card system is considered as the important criteria for their bank variety purposes. Finally, 17 (34%) respondents replied that the number of counter windows was taken as fairly important to them to select their current bank. In general respondents put that technology is considered for their bank variety.

Regarding the service quality and speed of the bank, most respondents 34(68%) determined that speed of the bank in rendering service is considered as important bank variety factor. Additionally, 26(52%) of respondents have shown that quality of the services at bank is important to their variety criteria. In general speed and quality of service at bank determines customers bank variety feature.

Concerning bank image and reputation, majority of the respondents replied that external appearance, sitting arrangements and the bank's total assets were not influential feature is bank variety decision. Whereas security and safety of the bank were fairly considered as an important feature considered by customers in their bank variety decision. Finally, number of branches and bank proximity were also considered as fairly important to their bank variety criteria by most respondents.

4.6 Analysis of managers' interview results

The purpose of conducting interview in this study is to add additional information about the main feature banks detected by themselves from customers and the responses given by them for those variety criteria.

In addition to the previous analysis, interviewing the bank manager has also makes the researcher to collect significant information for the study to have such kind of analysis. This interview has been conducted through face to face interview. In this section detection of main feature, what makes the banks competent with the banking industry and the responses made for the detected feature would be discussed in this part.

The interview result has shown that the bank have tried to collect information from customers about the services, facilities and provisions to be improved and all were detected the determining bank variety criteria taken by customers. Accordingly, the main types of services, facilities and provisions mostly requested to be improved by the customers were loan services specially the floor limit of loan amount and getting satisfactory responses, money transfer services in relation to its speed, overall speed of service provisions, provision of modern banking services such as ATM and card services.

In relation to the floor limit of the loan, the managers have tried to negotiate with those loan-customers, give satisfactory responses to borrowers and the real facts that the limit is not decided by the bank but by the National bank. With regard to the speeds of money transfer services manager have responded that the banking system should be interconnected with all available branches specifically, by now, united bank has being exerting its efforts for the realization of this.

In relation with the overall speed of service provisions, manger have believed that the only solution would be introducing modern paying or teller machines, interconnected banking systems and computerized service provisions. According to some managers ATM can be used to enhance customer service delivery, which could also pave the way for the reduction of the workload on tellers in banking halls. Such workload reduction could provide the tellers with opportunities for adequate interaction with customer and also help improve their functional efficiencies and effectiveness in customer service delivery.

Introducing modern banking technologies and modern visa cards, launching fast broadband internet connections among all branches and having adequately skilled manpower, working with foreign agents, providing all service items for customers, speed, giving satisfactory response for customers, paying interest for fixed deposit accounts monthly and paying interest for cheque accounts, were some of the main feature manager have forwarded that makes banks competent and preferable than others.

V. CONCLUSION AND RECOMMENDATIONS

Conclusion

In an attempt to assess customers bank variety criteria taking united bank Mekelle branch in to account this study has tried to shed a light on some important feature of customers bank variety decision. Therefore, some personal, technological and service quality at bank were considered as important feature to bank variety decision.

The general profile of the respondents revealed that the majority of the customers that is 32(64%) were males. And it is found that largest proportion 28 (56%) of respondents age lies in the age group of year 26-35. All the requested customers were attended formal schooling in which the majority of them completed at least high school study.

Majority of respondents 26 (52%) have monthly income of Br. 1000 – Br. 3000 and were mostly in private and self employed.

Concerning the bank variety feature, the study has identified feature such as pleasant and friendly bank staff, availability of ATM services, service quality and speed of the bank, number of branches and bank proximity as important bank variety criteria as perceived by customers.

Recommendation

From the findings of the study, the following recommendations are forwarded:

- Banks should be information oriented. That means information like why people prefer one bank over the other, differences and similarities in products offered by a given bank in a given area, etc. therefore, to know the

exact feelings and wants of customers bank should assess customers preference and priorities.

- Specifically reception at bank, friendly/pleasant manner of staffs, availability of ATM and other cards, service provision, adequate counter windows, service speed, service quality, number of branches and bank distance from home should be given proper consideration by banks to be preferable in competitive markets.

REFERENCES

- [1] Banking Sector Review. (December, 2010). Access Capital Investing in Ethiopia:
- [2] Almosawi, M. (2001). Bank variety criteria employed by college students in Bahrain:
- [3] An empirical analysis. *International Journal of Bank Marketing*, 19/3, PP.115-125, MCB University Press.
- [4] Aregbeyen, O. (2011). The determinants of bank variety choices by customers: Recent and extensive evidence from Nigeria. *International Journal of Business & Social Science* Vol. 2, No. 22.
- [5] Asrat, S. (June, 2010). Private sector growth vs. competitive banking in Ethiopia.
- [6] Gardachew, W. (August, 2010). Electronic-banking in Ethiopia- practices, opportunities and challenges. *Journal of Internet Banking and Commerce*, vol. 15, no.2.
- [7] Israel, G. D. (2003). Determination of sample size. University of Florida, Florida.
- [8] Kiyota, K., Peitsch B., & Stern, R. M. (August, 2007). The case for financial sector liberalization in Ethiopia. Research seminar in international economics, Discussion Paper No. 565.
- [9] Maiyaki, A. A. (2011). Feature determining bank's variety and preference in Nigerian retail banking. *International Journal of Business and Management*, Vol. 6, No. 1; Canadian Centre of Science and Education.
- [10] Boyd, W. L., Leonard, M., & White, C. (1994). Customer preferences for financial services: An analysis. *International Journal of Bank Marketing*, volume, 12, no. 1, 9-15.
- [11] Leibert, S. (2004). Determinants of choice criteria in Malaysia's retail banking: An analysis of gender based choice decisions. *European Journal of Economics, Finance and Administrative Sciences*, ISSN 1450-2275, Issue 16.

AUTHORS

First Author – Tewelde Fisahaye Meles, Lecturer in Mekelle University – Ethiopia, MSc in Finance and investment BED in Accounting, Mekelle University, CBE E-mail: wedifisahaye2@gmail.com

Live Video Streaming in Android Wearable Devices

Saminath.V

* Accenture, Bangalore

Abstract- Android is one of most popular open source operating system for smart devices like phones, tablet, set-top box, Android TV, Android Auto, and Android Wear. Most of the Smart devices has hardware capable of video processing and wireless streaming. This paper explains streaming of live camera content from Android Wearable Device like Watch to Handheld Mobile Phone/Tablet device. This Streaming content used for variety of Application in day to day life. Android Smart Device Consume and produce Live Video streaming and share video to another device. Bluetooth is more cost-efficient and power-efficient wireless communication layer to transfer media content between the devices. Bluetooth, making it ideal for small, light mobile devices, but not suitable for traditional media encoding and Real-time transmission due to limited Bandwidth, High degree of error rates, and the time-varying nature of the radio link. The media streaming over Bluetooth stances many challenges. This paper explains the protocol for media transmission content for Bluetooth, Camera and Bluetooth configuration, compressing technique on Wearable devices.

Index Terms- Mobile Ad-Hoc Networks, Android OS, Video Streaming, Android Wearable Device.

I. INTRODUCTION

Mobile multimedia content has central form of evidence for many solution. Most of the Smartphone equipped with hardware support for Video capture in real time, video processing and streaming in ad-hoc wireless communication network. Any Smart Device streams a real time video over multiple peer devices in network. Phones and smart device will be in same ad-hoc network by establishing a wireless link between the devices, it should be in communication range. By using android operation system develop the application for configure camera, capture live compress video, stream video to parried phone/smart device is simple.

Focal of this development is to provide a mobile Application using video streaming over BT network application with client-server architecture. General Application Android Wear technology is tailored made specifically for Google devices like Watch, Glasses. It comes with a new simplified interface with collection of fitness features. Smart watch has advanced health tracker application, it coaches and remind about workouts, speed, distance, and time information. Biometric tools/sensor in watch integrated with fitness Application. It monitors Heart rate and update average Heart Beat information in regular basis. The Android Wearable Device act as Client able to stream live camera content to Android Handheld Device like Mobile Phone/Tablet. Similar way Camera content from Mobile Phone/table to your watch. Bluetooth is wireless communication layer to transfer media content between the devices. The sensor information send to server along with media content information will provide more clarity on individual health conscious and tracking their fitness for extensive life cycle.

Bluetooth has three classes of connection scheme to form ad hoc networks, point-to-point, piconet and scatternet. Point-to-point connection between two devices with direct communication. Piconet is point -to-multipoint topology, one device acts as the master and the other devices play as a slave. In scatternet, slaves in one piconet can participate in another piconet as either a master or slave. This is most complex network scheme.

The recent research explains the various challenges for video streaming over Bluetooth links. Various components like Video Compression technique, Data lossy Control with protocols, Bluetooth socket programming explains the issues and give a clear picture on video streaming over Bluetooth. Each of the areas is one of the basic components in building a complete architecture for streaming video over bluetooth.

Figure-1 explains the video streaming over Bluetooth paired device. Raw image data to be compressed before transmit over the wireless device. Compression of video will be faster with hardware codec support on the processor, otherwise software codec leads time. Compressed video are packetized and send in payload segments with control modules adapts the media bit-streams, or regulates transmission parameters in protocol layer based on the current link status and stream requirements. It then sends the segmented packets to Bluetooth module for transmission. On the receiving side, the Bluetooth module receives media packets from air, reassembles them in the intermediate protocols, and sends them to decoder for decompression. Raw data of media will pass to Surface View to play.

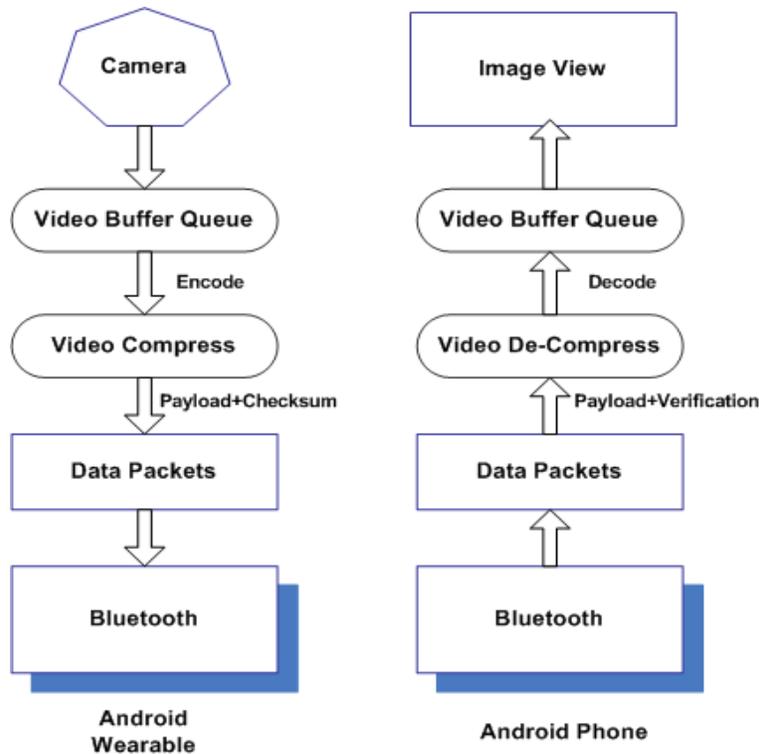


Figure-1 Block Diagram of Video Streaming

This paper is segmented into three parts. First portion explains specification of phone platform used for this development. In the second portion has architectural design used for media stream. The final portion covers the software development and protocol details.

II. HARDWARE PLATFORM

This development work on hardware platforms should run with Android platform. Samsung Galaxy Gear G700 is Android based Wearable device used for Capture image and stream media content via Bluetooth communication. Gear watch is light weight device which has 320x320 LCD display integrated with touch screen, 800MHz processor, Bluetooth and NFC communication interface, Hardware codec for image compress and decompress engine in-built, and runs with Android 4.2. Android phone used as server to receive media content and play the video's in Surface View.

Gear manager application needed for make connection between Galaxy Gear device and connected Android phone/tablet device. This application allows Gear device pairing with Smart phone. Two devices should paired with NFC communication and accepts the Google's verification. NFC Tag with share the credential information to Bluetooth in Gear device for paring and other managing applications.

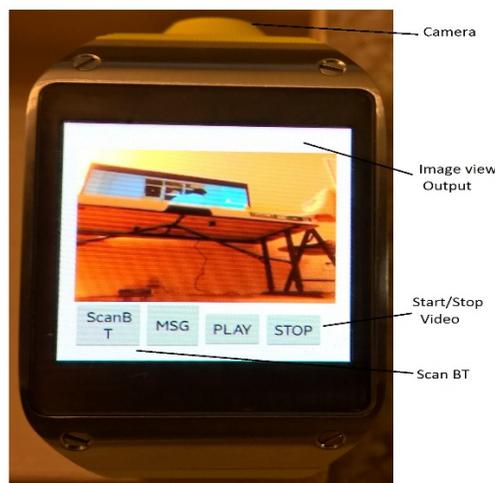


Figure-2 Samsung Watch Video Stream Screen

III. ARCHITECTURAL DESIGN

The Android Application is segmented into two major subsystems: First, the wearable client, it has Bluetooth wireless ad-hoc interface with Video streaming application for mobile phones for Android operating system. Wearable watch is a transmitter (camera, microphone) capture a video with the help of this application, user can share live information to receiver that might be parried with wireless and physically away. Second, the video streaming is based on peer-to-peer communication between mobile phones

Figure 3 shows protocol components for video streaming over Bluetooth links. The video compression is to remove redundant information form a digitized video sequence. Raw data must be compressed before transmission to achieve efficiency. Bandwidth of the bluetooth is limited to 500Kbps, it is very critical for video streaming. The media sever receives Messaging control protocol adapted with media bit-streams, or adjusts transmission parameters of intermediate layer based on the current link status and protocol requirements. It then sends the segmented packets to Bluetooth module for transmission. On the receiving side, the Bluetooth module receives media packets from air, reassembles them in the intermediate protocols, evaluate the media content information with other key parameters of the packet. The Image content is evaluate and sends message for re-transmission if required.

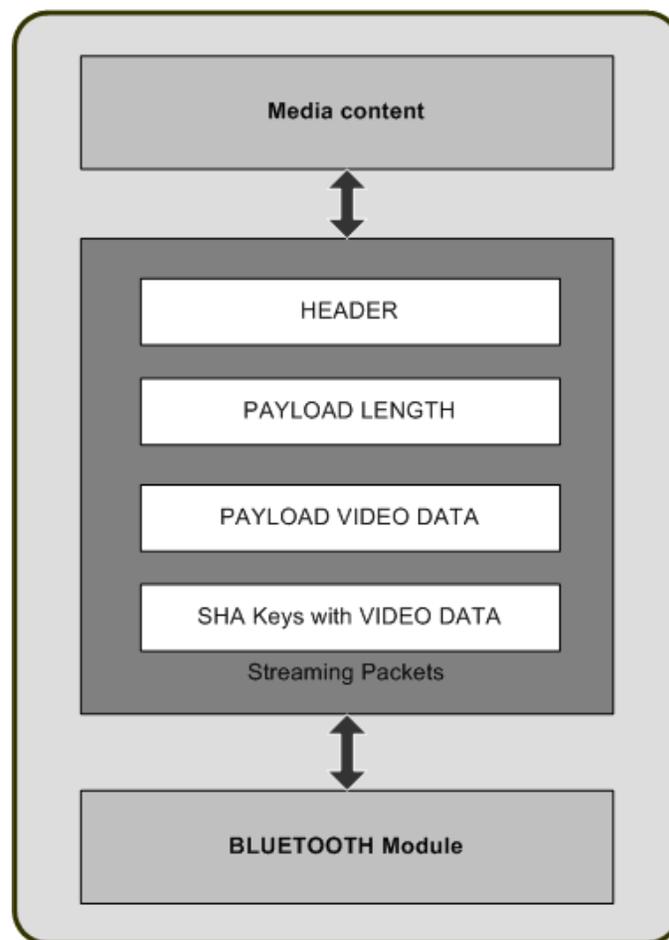


Figure-3 Payload of Video Streaming

The Media content is ready for transfer to parried device. Data packetized into custom protocol to avoid congestion and maximize video Quality with minimized packet loss.

- A. *Header Content:* Header has information about the Data content, it is fixed constant data customized for this communication in MSB and LSB format.

- B. *Payload Length Content*: Payload is the Valid Media content size information. It will be verified in receiving end. If any mismatch in payload length in receiving data, then packets are re-transmitted during video streaming.
- C. *Payload Content*: This is actual Media content captured by Wearable device. The Payload data is transferred chunks of packet and transmit to Phone. Size of the packet is 1024 byte for valid communication.
- D. *Payload Digest*: Calculate the Payload data content with MD5 Algorithm. This data can be calculate in the server side and find the Data loss or success content.
- E. *Acknowledgement*: Final data stream in the packet is Data failure or success information. If data transmitted failed, resend by the protocol.

Three major services involved in this design. Camera services, Bluetooth services, Protocol lightweight library service. The user interface sends notification for camera service to handle capture video encoder/decoder part. The user interference layer are send to the device layer with help of application layer. Message and Threads from the user interface layer are handled various physical device interaction and parallel activities. The interactions with the hardware are handles by the device layer. All the Application features of the phone necessary to handles, sending video streaming over bluetooth, and ports to send and receive data to and from the other Android phone. All three layers have its own interface that other layers can use to interact with it.

IV. SOFTWARE PLATFORM

The first programming step is to create a new Android Application Project in Android studio. It has Android Development Tools (ADT) configure with Android Wearable Device display Screen and other hardware configuration. The Project Wizard instruction has Application Name with Wear device selection of API 21: Android 4.4 (KitKat Wear) under Minimum SDK. The Blank Wear Activity creates with Android Wear screens with Rectangular (Android Wear Square) layout.

The primary object is Android device should have Bluetooth interface. This can be validate from the code. By creating BluetoothAdapter object using the function getDefaultAdapter() confirms the Bluetooth support in the Android device. If it returns NULL value, then the Android device does not support Bluetooth. If getDefaultAdapter return valid Bluetooth Adapter handler, then the Android supports Bluetooth. The next step is enable Bluetooth and find the parried device with our Bluetooth module, Gear Manager will helps to pair it. The Bluetooth Adapter’s getBondedDevices() function return Set of Bluetooth currently parried devices in collection. Each device scan and stored internal for further data communication. Establish connection between Android Wearable device and Android Phone. Create a Thread context to form a new Connection between two devices.

Thread uses Bluetooth Socket for communication port in each devices. Socket programing uses streaming of object for send and receive bytes. It create an InputStream and OutputStream from Bluetooth Socket. The InputStream is used for reading data coming from the Phone, and the OutputStream is used for sending data to the Wearable device. Presume that both the devices are already paired, and does not contain any logic to create pair relationships. The library access two thread types (ClientThread and ServerThread) depends on sending or receiving media content.

To create new camera instance, by opening a Camera with an id parameter. It defines the back facing camera or the front facing camera. Set the picture preview callback method and set the preview display method linked to Surface view layer of the camera instance. Get further information about its capabilities using theCamera.getParameters() method. Start preview method to start capture image and outputs of the image in surface view. For each frame image the callback is invoked. Inside preview callback image frame is compressed. The YUV Image class take the Image data, preview size information and compress into JPEG format. This image data convert to buffered stream data and stream to Bluetooth medium.

Buffered image data stored into Queues. Streaming packet created as per the Figure-3 mentioned. Header information has the Image type or compression type, each frame length in bytes format, image content stored into payload segment of the protocol layer. Payload size should be 1024 bytes only. If it exceeds then the packet will be transferred to next frame. Finally the image content send to MD5 algorithm to create two bytes of SHA key content. Various message communication used between two devices as stated in Table-1.

Table-1: Message Packet Information

DATA_UPDATE	Media content received from Wearable device and decoding started
DATA_RECEIVED	1024 byte Media Packet received completely. Verification process initiated.
DATA_SENT_SUCCESS / DATA_SENT_FAIL	Received payload data verified with MD5 verification.

	Return success or fail information
INVALID_HEADER	Header information is invalid
SEND_DATA	Android Phone send request to Wearable device, ready for receive the media content



Figure-4 Experimental of Live Video Streaming

Experiments results for video streaming as in Figure-4. The streaming data from camera is played in real-time on an Android Watch and passed over bluetooth. The received video streaming data decoded and played in Android phone, it has minimum delay on video play. There should be End-to-End Latency on the image compress and decompression and bandwidth of the communication medium and constraint in data transfer in each frame size. But for this development image size 1.3 megapixel camera with camcorder. Without Message packet protocol image date is lost in Android phone. Android phone calculate the image loss by verify the SHA content on the protocol and request Android watch resend the lost image packet information to Phone.

V. CONCLUSION

Bluetooth is a stimulating technology for mobile devices and serves the purpose transferring messages in wireless network environment. Streaming of Video over Bluetooth network is challenge with bandwidth constrain. This paper explains the Bluetooth specification, physical configuration, profile, android function implementation, intermediate protocol configuration, lossless data communication between devices, packetizing, streaming media contents. Explained Data control protocol works with Ad-Hoc network protocol layer, reduce packet damages, easy track of packet transfer states. This is more open protocol used in this project, easy integration with phone/tablet devices. Camera service is integrate in this work for live streaming. Android Wearable device has less resolution camera, image size is less with high quality information. During the Media streaming each compress frame has less size which will help intern avoid image cost. Bluetooth is a popular, well-supported, and effective protocol for wireless communication, and can enhance mobile apps that capable stream video from Mobile wearable device.

REFERENCES

- [1] Justin M. Bailey, "Live Video Streaming from Android-Enabled Devices to Web Browsers," *Graduate Theses and Dissertations.*, 2011.
- [2] Brian Wirsing, "Sending and Receiving Data via Bluetooth with an Android Device," , March 26, 2014.
- [3] Wang Xiaohang, "Video Streaming over Bluetooth: A Survey," *Institute for Infocomm Research (I2R) / School of Computing, NUS.*
- [4] Md. Muhaimin Rahman, Ashik-E-Rasul, "An Android Controlled Mobile Robot for Stereo Vision and Live Streaming with Robotic Arm," *International Conference on Mechanical, Industrial and Energy Engineering 2014.*
- [5] Hongfeng Xu and Zhen Chen, "Live Streaming with Content Centric Networking," *Research Institute of Information Technology.*

- [6] Sowmya and Mohan Kumar "VIDEO STREAMING USING WIRELESS MULTI-HOP IN ANDROID PHONES" *IJCET*, Volume 4, Issue 2, March – April (2013).

Identification and Classification of Rice varieties using Mahalanobis Distance by Computer Vision

Neelam*, Jyoti Gupta**

*Department of Electronics and communication, MMEC Ambala

**Department of Electronics and communication, MMEC Ambala

Abstract- In this paper, an algorithm for identification and classification of four different varieties of rice, using the color and morphological features is presented. The proposed algorithm consists of several steps:- Image acquisition, Image Segmentation, Feature selection and Extraction, identification and classification. The identification and classification is done by the Mahalanobis distance. The color features i.e.,(Red Green Blue) and morphological features i.e.,(Area, perimeter, MajorAxislength, MinorAxislength, eccentricity) are used for identification and classification purpose. RGB color modal is used. Mahalanobis distance is used as a identifier and also classifier.

Index Terms- color features, computer vision, feature extraction, feature selection, image segmentation, Mahalanobis distance, morphological features.

I INTRODUCTION

Rice is one of the most important cereal grain crops. The quality of rice seeds has distinct effect on the yield of rice, so the proper inspection of rice seed quality is very important. Quality of rice grains is required for protecting the consumers from sub standards products because the samples of food material are subjected to adulteration. For the identification and classification purpose, four varieties of rice i.e., Basmati, Tural, 6622, 1509 are used.

Manual Identification of object is based upon traditional visual quality inspection performed by human beings, which may be tedious, time-consuming, slow, less efficient and non-consistent. The research of human-computer interaction is no longer the design of devices and psycho-logical experiments of windows layouts, but evaluates to a new stage: intelligent interaction. One aspect is that computers should be able to accept audio and visual sensory inputs, and then make some kind of analysis and interpretation, and then provide intuitive feedbacks by synthesizing speech, video or actions. Fundamentally, besides speech recognition, computers should be able to recognize, interpret and understand human actions and behaviors from visual inputs. Technological advancement is gradually finding applications in identification and classification of objects in industry for quality purpose. It is one of great challenge to meet this requirement. Identification and classification of objects is accomplished based on attributes like appearance, color, shape and sizes.

Rice quality inspection by humans (relying upon the naked eye) is neither objective nor efficient. Error creep in sometimes due to inexperience or the inspection may be deliberately shifted out of sympathy for the producers. In view of this, automated rice quality inspection using computer vision is desirable to perform fast and objective quality measurement.

The color of rice is one of the main factors of the evaluating the quality. While detecting the rice varieties by the color features, people adopt more RGB color space and HSV color space; in addition, $L^*a^*b^*$ color space is also commonly used to extract the color feature value [2,3].

During the last decades several studies have been carried out related to the application of machine vision for quality evolution, Zhao-yan et al., 2005 proposed a method of identification based on neural network to classify rice variety using color and shape features with accuracy of 88.3% [7]. Verma (2010) extracted six morphological features (area, perimeter, maximum length, maximum width, compactness and elongation) to classify three varieties of Indian rice. A neural network was used with an accuracy ranging from 90 to 95% [8]. In another research, Van Dalan (2004) developed a method for determination of the rice size and the amount of broken rice kernels using image analysis [9]. Regarding the quality evaluation of rice, a new method has been developed to estimate the breakage and fissures ratio [10].

In a primary study Zayas et al., 1989 used machine vision to identify different varieties of wheat and to discriminate wheat from non-wheat components [11]. In later research Zayas et al., 1996 found that wheat classification methods could be improved by combining morphometry (computer vision analysis) and hardness analysis. Hard and soft recognition rates of 94% were achieved for the examined seventeen varieties [12]. In 978-1-4577-1535-8/11/\$26.00 ©2011 IEEE another report, the discrimination power of size, shape, color and texture for the identification of seeds of fifty seven weed species was assessed. Size and shape characteristics had larger discriminating power than color and texture ones. However, all of these features are required to reach an acceptable identification performance for practical applications [13].

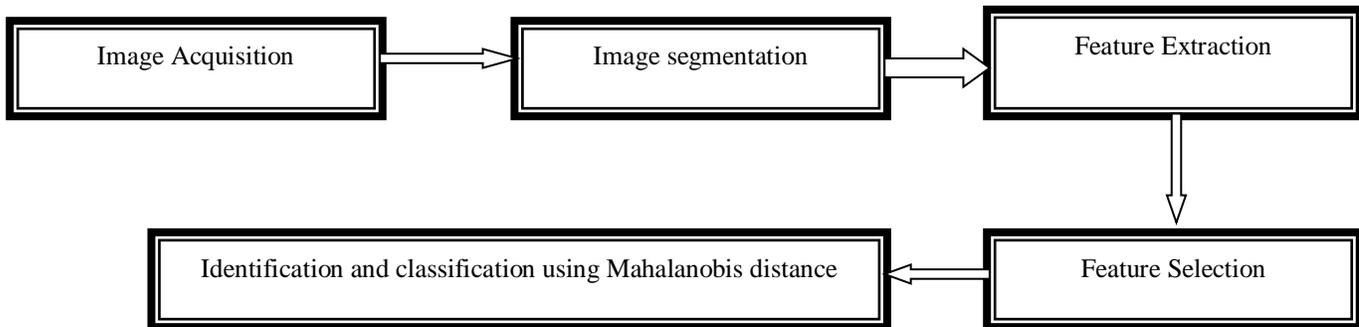
In this paper, we propose a simple, effective and high accuracy vision-based approach using Mahalanobis distance techniques to identify and classify rice varieties. The specific goal was to generate the optimal color and morphological features for classifying the

rice varieties with high accuracy using comparing the performance of the some feature selection algorithms during the classification process.

II METHODOLOGY

The block diagram shown in Fig. 1 illustrates the procedure for recognition and classification of rice grains.

Block diagram 1. Image recognition and classification of rice grains



A. Image Acquisition

In this work, RGB is used. RGB color model is used because red, green and blue are three primary colors. These are pure colors, no white light mixed to them. Many image segmentation approaches take advantage of this. Segmentation is usually performed in one color feature (hue) instead of three, allowing the use of much faster algorithm. A new approach for classification of rice variety using Mahalanobis distance will be presented.

A CCD (charge coupled device) color camera (Model Canon EOS 5 D Mark III) with resolution of 1670 pixels×1259 pixels will be used to record images. For image acquisition, a lens (Model Canon EF 75-300 f4-5.6 Mk III USM) with 102 mm focal length is fitted to the camera using an extension tube of 35 mm length. The camera is mounted on a stand which provided easy vertical movement and stable support for the camera. The exposure time is 1/125 sec. When the camera is fixed at the place 130 mm between the lens and the sample table, clear images of rice varieties are obtained.



Figure 2. (a)Basmati (b) Tural (c) 6622 (d) 1509

Every object could be situated in any random orientation and at any position inside the field of view. The background is a black paper. The color representation of objects of interest is relatively R (red), G (green), and B (blue) values at every pixel. The distant Gray level separation between background and objects made the image segmentation easier.

B. Image Segmentation

The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyse. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.[1]

In this work, morphological features and color features (RGB features) are required to be extracted. So the image must retain the color information of the rice varieties when segmentation is processed.

C. Features Extraction and Feature Selection

There are two features extracted by the given flow chart i.e., Morphological feature and color feature. Initially, RGB image is taken as input sample. The input image is form of pixels. First feature was Morphological feature. For extracting the morphological feature, process was started from reading the image. After reading the sample image, there was a need of conversion of RGB to GRAY image. Gray image is just retaining the luminance of the image (figure 3). Next step of conversion was Binarisation by thresholding(figure 4). In the binary image, it reduced the image into only two values (0, 1). Morphological Parameters were extracted by edge detection from binary image(figure 5). The selected parameters were Area, MinorAxislength, MajorAxislength, Eccentricity, Perimeter.

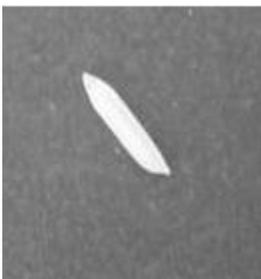


Figure 3

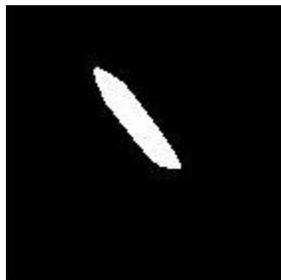


Figure 4

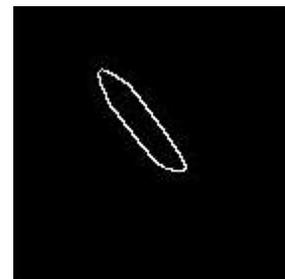


Figure 5

Second feature to be extracted was the color feature. There were different color values of RGB pixels within the specified range according to pure image. It includes selection of region of interest from RGB input image (figure 6) and RGB components were extracted (figure 7) and mean and covariance matrix was calculated .

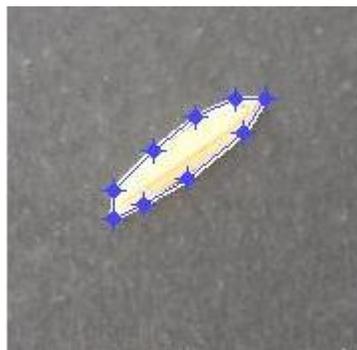


Figure 6

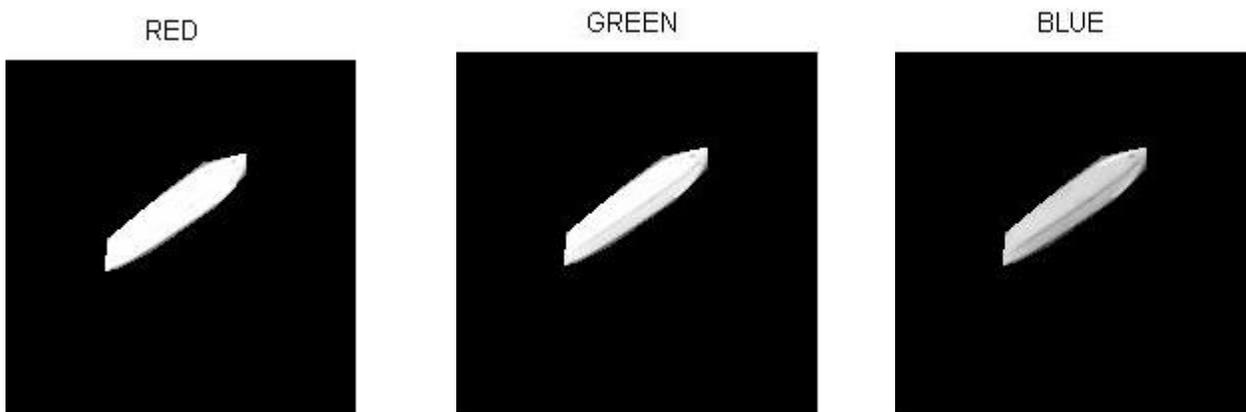


Figure 7

D. Object identification and classification

In this work, Mahalanobis distance was used for object identification and classification.

Mean Vector and covariance matrix computation:

From the coordinates of the points of RGB, the variance can be computed as:

$$\text{var}(R) = \sigma_{R,R} = 1/n - 1 \sum_{i=1}^n (R_i - R_o)^2$$

$$\text{var}(G) = \sigma_{G,G} = 1/n - 1 \sum_{i=1}^n (G_i - G_o)^2$$

$$\text{var}(B) = \sigma_{B,B} = 1/n - 1 \sum_{i=1}^n (B_i - B_o)^2$$

$$T_o = 1/n \sum_{i=1}^n T_i$$

where R_i, G_i, B_i , are the values of the i th match ($i=1, 2, 3, \dots, n$) and R_o, G_o, B_o are the values of the mean color given by

where $T = (R, G, B)$

Mahalanobis Distance

The Mahalanobis distance provides a relative measure of a data point's distance from a common point. The Mahalanobis distance is used to identify similarity of an unknown sample set to a known one. Theoretically, the Mahalanobis distance is simply the distance of the test point from the center of mass divided by the width of the ellipsoid in the direction of the test point.

Features of Mahalanobis distance: - Mahalanobis distance produces simple and efficient way for object identification. It takes distribution of the points (correlations) into account to classify observations into different groups. It takes into account not only the average value but also its variance and the covariance of the variables measured. It compensates for interactions (covariance) between variables and it is dimensionless.

Advantages of Mahalanobis distance: -

This algorithm produces good result for 2D as well as 3D images. The identification can also be achieved for occluded/hidden images. Mahalanobis distance is widely used in cluster analysis.

III Results and Discussion

The computer vision system was designed for identification and classification purpose. With four rice seed of different quality,40 images are taken ,10 for each rice seed from different position of rice at different angle from same distance using computer vision system and Mahalanobis distance is implemented for identification and classification of rice grains.

With reference to one reference image as shown in figure:



Reference Image

Mahalanobis distance is implemented to all rice seeds (test images) for identification .The Mahalanobis distance is found to be approximate similar for all basmati rice, i.e. 3.8213 , 12.7619 , 5.7460, 13.5522, 8.2823.

After calculating Mahalanobis distance, rice seed can be classified on basis of their color, size and shape attributes as shown below:

Type	Image	Mahalanobis Distance
BASMATI		3.0998-16.1702
TURAL		120.5513-662.5371
6622		8.5223-25.5441
1509		11.8660-196.5397

References

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image processing"
2. Bhupinder Verma, "Image Processing Techniques for Grading & Classification of Rice", Int'l Conf. on Computer & Communication Technology, 978-1-4244-9034-1/10/\$26.00©2010 IEEE.
3. V. n. Nguyen, "Fao Rice Information," , Fao, 2000
4. J. Cai, "an analysis of color models and criteria for their applications to quality test of farm products," Journal of JiangSu university of science and technology, Vol. 18, 1997, pp. 22-25.
5. T.Vizhanyo, J. Felfoldi, "Enhancing color differences in image of diseased mushrooms," computer and electronics in agriculture, Vol. 26, 2000, pp. 187-198.
6. R. Haralick, K. Shanmugam, I.Dinstein, "Textural features for image classification" , IEEE transactions on systems, man and cybernetics, Vol. 3, pp. 610-621
7. A. K. Jain, R. P. W. Duin, J. Mao, "Image textural features as indicators of beef tenderness", meat science, Vol. 53, pp. 17-22.
8. O. Basset, B. Buquet, S. Abouelkaram, P.Delachartre, J. Culioli, "Application of texture image analysis for the classification of bovine meat", Food Chemistry, Vol. 69, PP. 437-445
9. L. Zhao-yan, C. Fang, Y.Yi-bin, R-Xiu-qin, "Identification of rice seed varieties using neural networks," Journal of Zhejiang University Science, Vol. 11, 2005, pp. 1095-1100.
10. B. Verma, "Image Processing Techniques for grading & classification of rice," Int'l Conf.on Computer & Communication Technology (ICCT 10),2010,pp. 220-223.
11. G.Van Dalan, "Determination of the size distribution and percentage of broken kernels of rice using flatbed scanning and image analysis," Food Research International, Vol.37, 2004, pp. 51-58.
12. F. Courtois, M. Faessel and C.Bonnazi, "Assessing breakage and cracks of parboiled rice kernels by image analysis technique," Food Control, Vol. 21, 2010, pp. 567-572.
13. I. Zayas, Y. Pomeranz, F. S. Lai, "discrimination of wheat and nonwheat components in grain samples by image analysis," Cereal Chemistry, Vol. 66, 1989, pp. 233-237.
14. I. Y. Zayas, C. R. Martin, J.L.Steele, A. Katsevich, "wheat classification using image analysis and crush force parameter," Transaction of ASABE, Vol. 39, 1996, pp. 2999-2204.
15. P.M. Granitto, H. D. Navone, P. F. Verdes, H. A. Ceccatto, " Weed seeds identification by machine vision," Computers And Electronics In Agriculture, Vol. 33, 2002, pp. 91-103.
16. P. M. Granito, P. B. Verdes,H. A. ceccatto, "large scale investigation of weed seed identification by machine vision," Computer And Electronics In Agriculture, Vol. 47,2005,pp. 15-24.
17. P. M. Narendra, K. Fukunaga, "A branch and bound algorithm for feature subset selection," IEEE Transactions on Computers, Vol. 100, No. 9, 1977, pp. 917-922
18. P. A. Devijver, and J. Kittler, "Pattern Recognition: a Statistical Approach", Prentice/Hall, 1982
19. S.D. Stearns, "on selecting features for pattern classifiers," The Third International Conforance of pattern recognition , 1976, pp. 71-75
20. S. P. Shouche, R.Rastogi , S. G.Bhagwat, "Shape analysis of grains of Indian wheat varieties" Computers And Electronics In Agriculture, vol. 33, 2001, pp. 55-76. [1] V. n. Nguyen, "Fao Rice Information," , Fao, 2000

Intermolecular interactions identified with velocity of Ultrasound in Vanilin at different temperatures

B.S.Srikanth*, Dr.S.Sekar**,Dr.R.Ramasamy*

* Department of Physics, National College, Tiruchy, TN.

** (ASI),Department of Physics, Oxford Engineering College, Tiruchy.

Abstract- The thermodynamic and acoustical study elucidates the nature of interactions between molecules in liquids and solutions. Also ultrasonic parameters are directly related to a number of thermodynamic parameters. As the different liquid state theories are based on thermodynamic considerations, the study of propagation of ultrasonic waves in liquid systems is established as a simple and effective tool in determining the nature of interactions between molecules in liquids and solutions. Using ultrasonic velocity measurements, Adiabatic Compressibility, Rao's Constant, Wada's Constant, Specific Acoustic Impedance and Intermolecular Free Length are evaluated and the variations are analyzed. Structure making and Structure breaking nature of solution is studied using Internal Pressure variations.

Index Terms- Velocity, Adiabatic compressibility, Internal Pressure, Free volume.

I. INTRODUCTION

The structure of liquids is well established than that of gases or solids. Despite a great deal of research in this area, we still do not have a clear picture of the way in which molecules

are arranged in even the most common liquid, water. Ultrasonic studies of electrolytic solutions yield valuable information about the nature and strength of molecular interactions. The estimation of ultrasonic velocity, help us to evaluate the Internal Pressure, Free Volume, Compressibility, Rao's Constant and Wada's Constant, which provides a wealth of information about the state of liquid. It explains many of the properties of liquids and solutions. Even microscopic changes occurring in the medium like in molecular orientations or in temperature will change the value of Internal Pressure. From the acoustic parameters the ultrasonic behaviour of Vanilin was assessed.

II. EXPERIMENTAL STUDIES

The aqueous solution of Vanilin (AR Grade) is dissolved in double distilled water for making up different concentrations under study. A Mittal type fixed frequency Interferometer (2 MHz) is used for the determination of Ultrasonic Velocity. A circulating thermostat is used to maintain the temperature of the system at constant temperature variation studies.

III. MATHEMATICAL FORMULAS

Ultrasonic Velocity (U) = $\lambda \times f$

λ = wavelength f =frequency Where $\lambda=2d/n$

Adiabatic Compressibility: $\beta = (1/u^2\rho)$

$$L_f = \left(\frac{K}{U_p^{1/2}} \right) = K(\beta_{ad})^{1/2}$$

Intermolecular free length (L_f):

Relaxation time (t) = $4\eta / (3\rho U^2)$

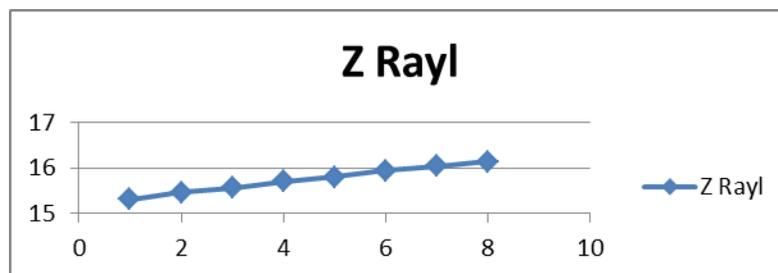
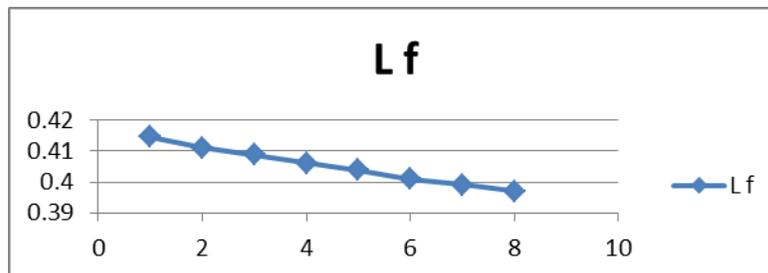
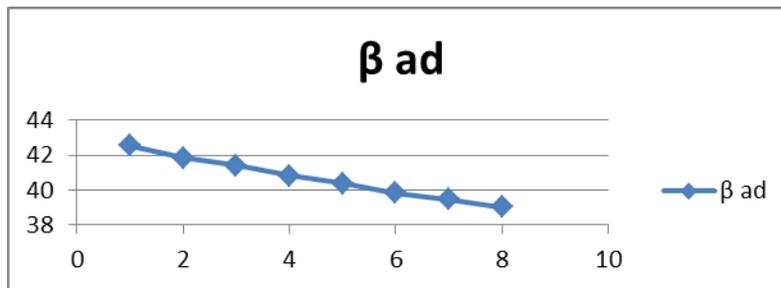
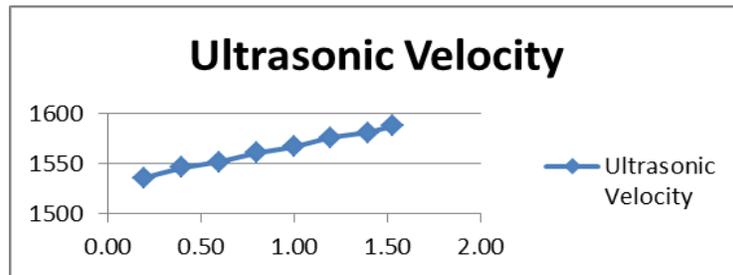
Specific Acoustic Impedance(z)= $\rho * U$

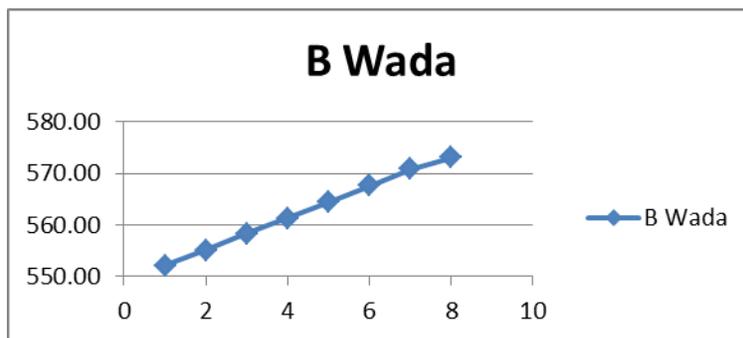
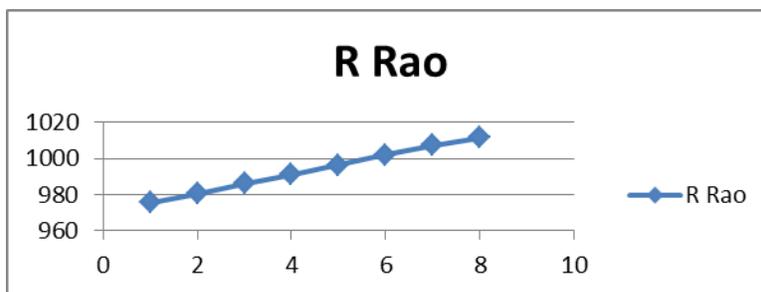
$$R = \frac{M}{\rho} \bullet u^{1/3}$$

Rao's Constant(R)=

$$\text{Wada's Constant(W)} = \left[\frac{M}{\rho} \right] (\beta_{ad})^{-1/7}$$

Molality	Ultrasonic Velocity	β ad	L f	Z Rayl	R Rao	B Wada
0.20	1536	42.52	0.4145	15.305	975.62	552.15
0.40	1546	41.83	0.4111	15.462	980.61	555.12
0.60	1552	41.38	0.4089	15.567	986.01	558.29
0.80	1561	40.81	0.4061	15.702	990.98	561.24
1.00	1567	40.38	0.4039	15.807	996.29	564.35
1.20	1576	39.81	0.4010	15.942	1001.98	567.64
1.40	1581	39.44	0.3992	16.034	1007.41	570.81
1.53	1588	39.03	0.3971	16.133	1011.34	573.07





Molality	internal pressure	free volume
0.20	23662	0.03151
0.40	23582	0.03109
0.60	23431	0.03124
0.80	23317	0.03145
1.00	23202	0.03172
1.20	23028	0.03214
1.40	22939	0.03231
1.53	22827	0.03260

IV. RESULTS AND DISCUSSION

The experimentally determined values of Ultrasonic Velocity for Vanilin at different concentrations are summarized in the table.

The measurement of ultrasonic velocity is an important tool to study the physical & chemical properties of the liquid. Ultrasonic velocity and allied parameters of Vanilin for various concentrations are presented in tables and represented graphically in figures.

The parameters derived from ultrasonic measurements such as Adiabatic Compressibility, Intermolecular Free Length, Specific Acoustic Impedance, molar sound velocity and molar compressibility prove a better insight into molecular environment in liquid mixtures and solutions.

In this the ultrasonic velocity increases with increase in both temperature and concentration.

The plot between the ultrasonic velocity and concentration potential shows that the ultrasonic velocity is found to linearly increase with concentrations. This linear increase suggests that there are strong solute-solvent interactions in the liquid solution. These interactions are both concentration and temperature

dependent. The effects of temperature on the interactions are more than that of concentration. At low concentrations, the number of hydrogen bonds formed may be less and at higher concentrations, it may be more due to solute-solute interactions [Graph1].

The compressibility is a macroscopic observable, which is sensitive to solute-solvent interactions. Any modifications induced by the solute on the local structure of the solvent generate changes in the Adiabatic Compressibility of the solutions and therefore compressibility can be used to characterize solvated properties of solute in dilute solutions. The decrease of Adiabatic Compressibility with Concentrations of all the solutions studied here indicates the formation of a more number of tightly bound systems. This implies, the β is decreasing with Concentration[1]. This is seen from the fact that the Velocity is equal to the square root of the reciprocal of β with density [Graph 2].

The intermolecular free length of the liquid systems decreases with increase in concentration. The free length is the distance between the surfaces of the neighboring molecules. It indicates significant interactions between the solute and solvent molecules, due to which the structural arrangement in the

neighborhood of constituent solute particles is considerably affected. At lower concentrations, the molecules are not closer and then the Intermolecular Free Length will be high[2]. As the concentration increases, the molecules come closer, there by decreasing the intermolecular free length [Graph 3].

The usual behavior of the linear increase of Specific Acoustic Impedance with Concentration at a given temperature is observed in the system studied here. The Specific Acoustic Impedance in liquids can also be used to assess the strength of Inter-Molecular Attraction[3]. As the strength of the intermolecular attraction increases, the ultrasonic velocity also increases consequently, the acoustic impedance value also increases. Acoustic impedance is a characteristic property of the medium [Graph 4].

The variations of Molar Sound Velocity (Rao's constant) and Molar Compressibility (Wada's constant) show increasing trend with the variation of concentration at 303k as expected [Graph 5 & 6].

REFERENCES

- [1] Sathyanarayana.B & Sathyanarayana.N, Jou.of.pure and App.Phy. Ind. August (2006).
- [2] Sarat.K Swain, Priyadarshini.P, Jou.of.pure and App.Phy. Ind Aug 2010.
- [3] Rice. O.K., J. Chem. Phys., 5 353 (1937).
- [4] Hildebrand JH, Science (USA), 174 490 (1971).
- [5] Hildebrand Jh & Lamereaus Rh. Proc Natl Acad Sci (USA) 69, 3428 (1972)
- [6] Kannappan.V, Indira Gandhi.N,Jou.of.pure and App.Phy. Ind. March (2007)
- [7] Gandhimathi. K et. al Journal of Acoustical Society of India Nov. 1990.
- [8] Gandhimathi. K. et. al Journal of Acoustical Society of India vol XXVIII (3&4) 61 (1990)
- [9] Gandhimathi. K. et. al Journal of Acoustical Society of India. 1992
- [10] Kannappan.V,Vinayagam,S.G,Jou.of.pure and App.Phy. Ind. Sept (2006).
- [11] Kannappan.V,Jayakumar,S, Jou.of.pure and App.Phy. Ind Dec 2007.
- [12] Gandhimathi. R. et. al Journal of Acoustical Society of India. Dec. 1998, vol XXVI NOS. 3&4, P 133-136.
- [13] Gandhimathi. R. et. al Journal of Acoustical Society of India. 1999, vol XXVIII NOS. 1&4, P 355-358.
- [14] Gandhimathi. R. et. al Journal of Acoustical Society of India. Nov 2000, vol XXVIII NOS. 1-4, P 321-324.
- [15] Gandhimathi. R. et. al Journal of Acoustical Society of India. Nov 2000, vol XXVIII NOS. 1-4, P 325-328.
- [16] Gandhimathi. R. et. al Journal of Acoustical Society of India. Nov 2001, vol XXIX NOS. 1 P 56-60.
- [17] Gandhimathi. R. et. al Journal of Acoustical Society of India. Nov 2001, vol XXIX NOS. 1 P 140-145.
- [18] Ragamathunnisa M., Jasmine Vasantha Rani E., Padmavathy R., Radha N., IJCRR 2012; 4(23): 30-41
- [19] T Sumathi, M Varalakshmi - Rasayan J. Chem, 2010
- [20] KN Mehrotra, SK Upadhyaya, (1988) J. Industrial Research. 1988..
- [21] Palani, A. Geetha, SVSL Poornima, (2011) International Journal of Research in Pure and Applied Physics
- [22] M Gowrisankar, P Venkateswarlu... - Journal of Industrial and ..., 2013 - Elsevier
- [23] MG Sankar, V Ponneri, KS Kumar... - Journal of Thermal ..., 2013 - Springer
- [24] J. D. Pandey,a Ranjan Dey*a and J. Chhabraa PhysChemComm, 2003,6, 55-58
- [25] I. F.J. Millero, A. Surdo and Shinc, J. Phys. Chem., 82, 784 (1978).
- [26] S. Cabini, G. Conti, E. Matteoli and M.R.Tine, J. Chem. Soc. Faraday Trans., 77, 2385 (1981)
- [27] H. Holiland, J. Soln. Chem., 9, 857 (1980).
- [28] J.V. Layendekker, J.Chem. Soc. Faraday Trans., 84, 397 (1988).
- [29] G.R. Hedwig and H. Holiland, J. Chem. Thermodyn., 23, 1029 (1991).
- [30] R. Bhat and J.C. Awuwalia, J. Phys. Chem., 99, 1099 (1985).
- [31] R.K. Wadi and P. Ramasami, J. Chem. Soc. Faraday Tran., 93, 243 (1997).
- [32] Rohini Badarayani and Anil Kumar, J. Chem. Thermodym., 35, 897 (2003).
- [33] Gagandeep Singh and T.S.Banipal, Ind.J.of. Chemistry, 47A 1355(2008)

AUTHORS

First Author – B.S.Srikanth, Department of Physics, National College, Tiruchy, TN.
Second Author – Dr.S.Sekar, (ASI),Department of Physics, Oxford Engineering College, Tiruchy.
Third Author – Dr.R.Ramasamy, Department of Physics, National College, Tiruchy, TN.

Cost Adjustment of Fertilizer (Urea) Against Production Expenditure by Using Mathematical Methods of Operation Research Specific Linearity Control Bias-Slope Adjustment (OR-LSB)

Abdul Mannan^{1*}, Nasir uddin Khan², Mushtaq Hussain³, Sumaira Yousuf⁴

^{1*}Research Fellow and Corresponding Author, Department of Mathematics, University of Karachi, Karachi, Pakistan
 E-mail: mannan.maths@gmail.com

(*Corresponding Author)

²Department of Mathematics, University of Karachi, Karachi, Pakistan

³Dean of Sciences, Newport University, Karachi, Pakistan

⁴Research fellow, Department of Mathematics, University of Karachi, Karachi, Pakistan

Abstract- The price factor is a direct index of profitability for any process which produced the items the cost adjustment is a mathematical technique which when implemented gives a better return an investment by keeping extra cost away from main process costing the mathematical method used in this paper is a system of equation relating fixed parameters of structural expenditure like machinery, transport, raw storage material extras with the main variable parameters like raw material such as natural gas produced from fertilizer.

Index Terms- Cost adjustment, prices index variable, cost parameter, fixed cost parameter, profitability index, and modified system.

I. INTRODUCTION

This research paper is core study of local fertilizer company producing urea from natural gas. The cost of infrastructure and other accessories was initially very high due to imported items required for erection and installation of manufacturing plant. The management of the investment group was working on a feasibility of previous working group with an estimated cost of 4.5 billion Pak rupees. The return of investment with design production capability was expected in 10 years as maximum of 45%. So it was a profitable project with coat of merits. Such as availability of the fertilizer within vicinity of field farmers Fauji Fertilizer Company Limited (FFC) district Sadiqabad Mirpur Mathailo, Fatima Fertilizer (FF) Sadiqabad, Rahim Yar Khan. At present the factory is producing huge quantity of urea but the cost of manufacture is beyond the price factor of a local market which is badly disturbed by the Indian and Chinese products

II. METHOD AND METHODOLOGY

The mathematical model of the process is by furcated into main key operator modules governed by the specific relation expressed as mathematical expressions

$$\sum_{i=0}^r = np^r + ka \tag{1}$$

$$\sum_{i=0}^s = mq^s + kb \tag{2}$$

$$\sum_{i=0}^{r+s} = nq^{r+s} + kc \tag{3}$$

$$\sum_{i=0}^{r-s} = mp^{r-s} + kd \tag{4}$$

Where k_a, k_b, k_c, k_d are the fixed cost factor and n, m and r the coefficient of the productivity and p and q are the essential manufacturing cost r and s the frequency of the repeat cycle.

The solution of all four equations is the final index for price adjustment by calculating the hidden parameters in manufacturing process mathematical illustration of the main model.

When a process starts with a lateral frequency of repetition say r times then for every cycle starting from r_0 up to r_r
 Hence:

$$r_0, r_1, r_2, r_3, r_4, r_5 \dots \dots \dots r_r$$

Then the actual cost of the process will be reduced for every cycle by an amount of a coefficient n likewise m is the coefficient of increase in term of variable of expenditures like salaries, utilities and material cost for each cycle say s times then for every cycle starting for from s_0 to s_s

$$s_0, s_1, s_2, s_3, s_4, s_5 \dots \dots \dots s_s$$

The main process cost p which a direct cost index of the raw material an accessories and the q is the indirect cost of production like utilities electricity, water, gas and salaries etcetera.

The first equation is the material equation, second equation is the labor equation (services), third equation is the effect of material over services and fourth equation is the effect of service over material (provision)

III. MATHEMATICAL WORKOUT

For a given time where r and s are different like in three shifts only one production cycle ($s = 3, r = 1$) and likewise if four cycle of production with two shift ($s = 2, r = 4$) the actual rate of change between any two parameters can be estimated by using differentiated in time keeping in main equation.

Quantum as α and t is the process cycle (time) where $t = 1, t = 2, t = 3$ and $t = 4$

$$\alpha_1 = \frac{d\alpha}{dt} = \frac{d}{dt} (np^r + ka) \tag{5}$$

$$\alpha_2 = \frac{d\alpha}{dt} = \frac{d}{dt} (mq^s + k_b) \tag{6}$$

$$\alpha_3 = \frac{d\alpha}{dt} = \frac{d}{dt} (nq^{r+s} + k_c) \tag{7}$$

$$\alpha_4 = \frac{d\alpha}{dt} = \frac{d}{dt} (mp^{r-s} + k_d) \tag{8}$$

IV. FORMULA EXTRACTION

In the scenario of production and material cost variation during one cycle of operation the change in the in the services value and non-productive cost on various entities like management transportation medical facilities and supporting services make the formula structure as an average of ratio between two essential cost and the two non-essential cost the summation the primary cost per cycle is summed up to nearest possible factor closed to the highest value in the data table after the normalization of data per α Column per year the average value is formulated by a factor of variability labeled as α it has four value coefficient like $\alpha_0, \alpha_1, \alpha_2, \alpha_3$ and α_4 , where α_1 and α_2 are the essential cost it cannot be changed for one cycle but α_3 and α_4 can be adjusted by the reducing the structural cost or fixed cost in this scenario on the actual cost will be vary closed to profitability factor the design factor of adjustment profitability factor is below

$$p_F = \frac{\alpha_1 + \alpha_2}{\alpha_3 - \alpha_4}$$

Table-1
COST MANUFACTURING QUARTERLY
(ALL PRICES ARE IN BILLION PKR)

Year	Cycle (C ₁)	Cycle (C ₂)	Cycle (C ₃)	C ₁ + C ₂ + C ₃
2005	6.2	10.1	9.8	26.1
2006	7.2	9.1	9.6	25.9
2007	7.8	9.5	10.2	27.5
2008	8.3	10.1	9.7	28.1
2009	9.4	10.7	9.7	29.8
2010	10.1	9.9	9.8	29.8
2011	11.4	9.4	9.9	30.7
2012	12.9	10.2	10.0	33.1

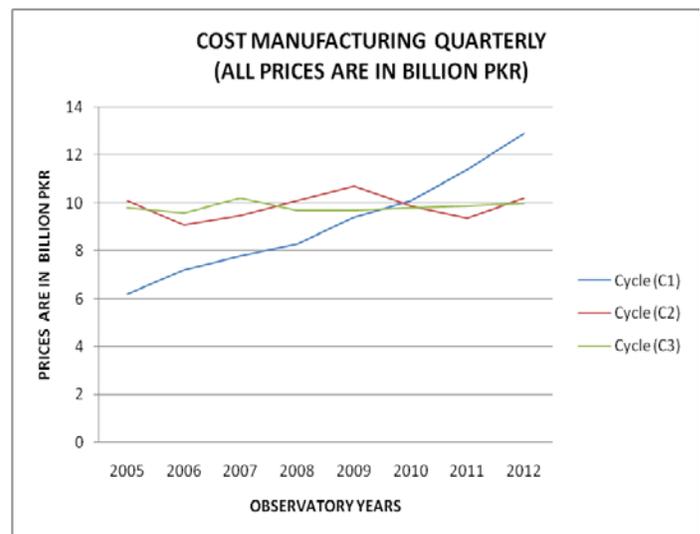


Table-2
NON PRODUCTIVE EXPENDITURE COST
QUARTERLY (ALL PRICES ARE IN BILLION PKR)

Year	Cycle (C ₁)	Cycle (C ₂)	Cycle (C ₃)	C ₁ + C ₂ + C ₃
2005	4.2	4.5	9.6	18.3
2006	4.6	4.1	8.4	17.1
2007	4.7	4.4	9.2	18.3
2008	4.7	4.5	9.1	18.3
2009	4.9	4.9	9.2	19.0
2010	5.6	5.5	9.6	20.7
2011	5.9	5.9	9.9	21.7
2012	6.2	6.4	10.4	23.0

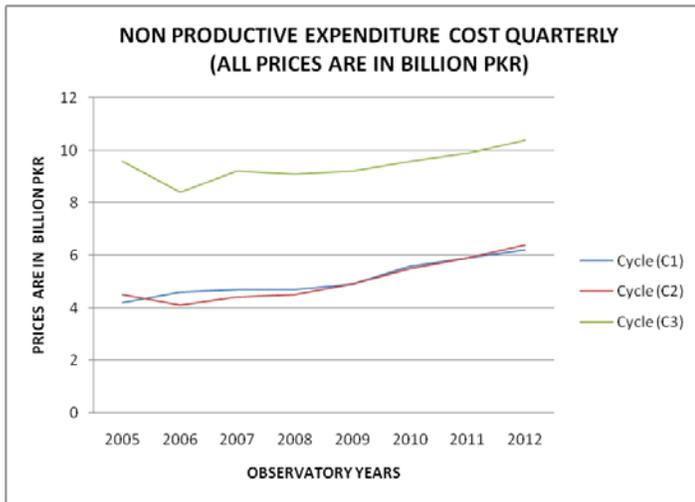


Table-3
PRODUCTION SERVICES COST QUARTERLY
(ALL PRICES ARE IN BILLION PKR)

Year	Cycle (C ₁)	Cycle (C ₂)	Cycle (C ₃)	C ₁ + C ₂ + C ₃
2005	7.2	9.2	11.2	27.6
2006	8.9	11.1	12.4	32.4
2007	11.2	11.7	12.4	35.3
2008	12.9	12.0	13.9	38.8
2009	12.4	11.9	14.1	38.4
2010	13.3	12.1	13.9	39.3
2011	13.7	13.1	13.8	40.6
2012	15.5	13.7	13.4	42.6

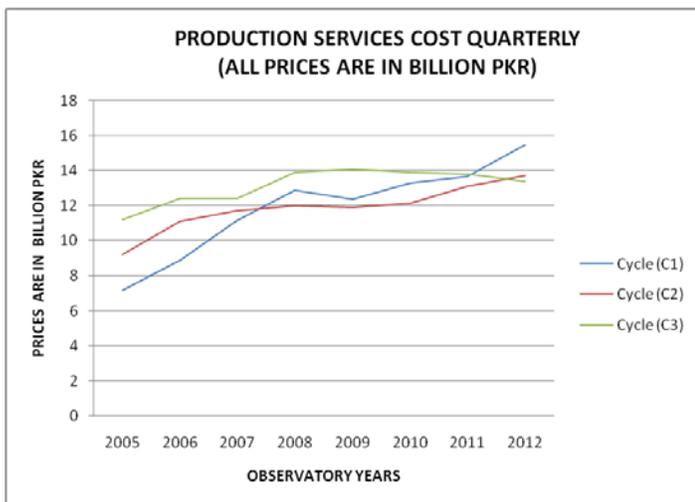
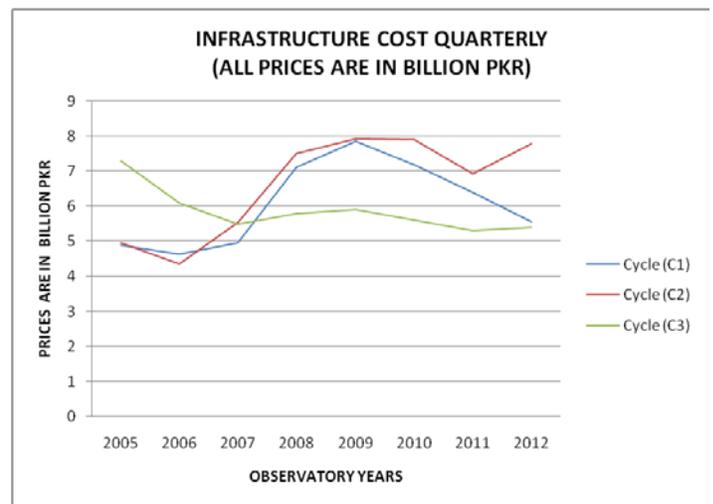


Table-4
INFRASTRUCTURE COST QUARTERLY
(ALL PRICES ARE IN BILLION PKR)

Year	Cycle (C ₁)	Cycle (C ₂)	Cycle (C ₃)	C ₁ + C ₂ + C ₃
2005	4.89	4.97	7.3	17.16
2006	4.63	4.36	6.1	15.09
2007	4.95	5.55	5.5	16.00
2008	7.11	7.51	5.8	20.42
2009	7.85	7.93	5.9	21.68
2010	7.19	7.91	5.6	20.7
2011	6.39	6.94	5.3	18.63
2012	5.57	7.8	5.4	18.77



V. RESULT EXTRACTION P_F

For all three cumulative cycles the mean value will indicate the actual index per year and median of the five year of the production cost will represent the actual production cost.

If the P_F value of the index is (0.9 < P_F = 1) then model is fit for profitability over price of fertilizer and if this index is (P_F ≤ 0.9) fertilizer costing not fit for profit.

VI. RESULT & DISCUSSION

The calculation of the price adjustments using the simple mathematical models is successful in third world countries like Pakistan where value added pricing is not applied and is not predicted the major portion of our working class the salary paid and the farmers other agricultural operative entities are not included in the tax structure but the agricultural product is highly dependent upon fertilizer then for the price structure of the fertilizer is a deciding factor of productivity the main objective of the price adjustment of the major group of fertilizer is the controlled price implemented by government authorities. The agriculture showing season the dealer price of fertilizer is under the control structure of the supplier to the manufacturer like FFC, FF and ENGRO. Our mathematical model adjust the cost over price structure such that no gap between primary expenditure and find production of the fertilizer by providing essential index is in

such a way that all four parameters are well adjusted for the utility and cycling backs the process.

VII. CONCLUSION

The above designed mathematical model works affectively without any changing the commercial activity or productive capability or the available cost of fertilizer in commercial market the main reason for this performing of the model is its sample formulation considering cost factor on production and its distribution. The price of fertilizer against the cost of product the biggest problem of fertilizer increasing the cost production and low distribution profile in commercial market

REFERENCES

- [1] Fertilizer Advisory, Development and Information Network for Asia and the Pacific (FADINAP)
- [2] Timmer, C. Peter. "The Demand for Fertilizer in Developing Countries" Food Research Institute Studies. Vol. XIII, No. 3. 1974.
- [3] Fertilizer policy (2001)
- [4] Munir Ahmad, M.Ghafar Chaudry and Ghulam Mustafa Chaudhry. "Non-price Explanatory Variables in Fertilizer" The Pakistan Development Review. 39:4 Part II (Winter 2000) pp.477-486
- [5] USDA (US department of agriculture) "Increasing Production Cost.
- [6] National Fertilizer Development Center "Pakistan Fertilizer Statistics" Islamabad NFDC
- [7] Huang, Wen-yuan (b). "Impact of Rising Fertilizer Prices on Cash Returns for Major Crops, 2000-2007," Paper presented at CASE/NAREA Conference, Quebec City, Quebec, Canada, June 30-July 2, 2008.
- [8] Chauhan, Meena. Personal communication with market analyst - Sulphur/Agriculture, Fertecon Ltd., October 15, 2008.

- [9] "[About Operations Research](#)". INFORMS.org. Retrieved 7 January 2012.
- [10] "[Operations Research \(Industrial Engineering\) :: History – Britannica Online Encyclopedia](#)". Britannica.com. Retrieved 13 November 2011.
- [11] Kirby, [p. 117](#), [^](#) Kirby, [pp. 91–94](#), [^](#) Kirby, [p. 96,109](#), [^](#) Kirby, [p. 96](#)
- [12] A. C. Gaur, Handbook of Organic Farming and Biofertilizers, Ambica Book Publication, Jaipur, India, 2006.
- [13] K. Thanunathan, S. Natarajan, R. Sentikumar, and K. Asulmurogan, "Effect of different sources of organic amendments on growth and yield of onion in mine spoil," Madras Agricultural Journal, vol. 84, no. 7, pp. 382–384, 1997. [View at Google Scholar](#).

AUTHORS

First Author (Correspondence Author) – Abdul Mannan, MSc (Industrial & Business Mathematics), MA (Mathematics with Applied and Pure Subject), Department of Mathematics, University of Karachi, Karachi, Pakistan
E-mail: mannan.maths@gmail.com

Second Author – Nasir uddin Khan, PhD (Mathematics), Department of Mathematics, University of Karachi, Karachi, Pakistan

Third Author – Mushtaq Hussain, PhD (Mathematics), Department of Mathematics, University of Karachi, Dean of Sciences, Newport University, Karachi, Pakistan

Fourth Author–Sumaira Yousuf, MSc(Mathematics), Department of Mathematics, University of Karachi, Karachi, Pakistan

Data Warehousing, Data Mining, OLAP and OLTP Technologies Are Indispensable Elements to Support Decision-Making Process in Industrial World

Amandeep Kour

Assistant Professor, "Department of Computer Science and Engineering"
M.B.S College of Engineering & Technology, Babiliana, Jammu (J&K) India

Abstract- This paper provides an overview of Data warehousing, Data Mining, OLAP, OLTP technologies, exploring the features, new applications and the architecture of Data Warehousing and data mining. The data warehouse supports on-line analytical processing (OLAP), the functional and performance requirements of which are quite different from those of the on-line transaction processing (OLTP) applications traditionally supported by the operational databases. Data warehouses provide on-line analytical processing (OLAP) tools for the interactive analysis of multidimensional data of varied granularities, which facilitates effective data mining. Data warehousing and on-line analytical processing (OLAP) are essential elements of decision support, which has increasingly become a focus of the database industry. OLTP is customer-oriented and is used for transaction and query processing by clerks, clients and information technology professionals. An OLAP system is market-oriented and is used for data analysis by knowledge workers, including managers, executives and analysts. Data warehousing and OLAP have emerged as leading technologies that facilitate data storage, organization and then, significant retrieval. Decision support places some rather different requirements on database technology compared to traditional on-line transaction processing applications.

Index Terms- Data Warehousing, OLAP, OLTP, Data Mining, Decision Making and Decision Support, Data mining, Data marts, Meta data, ETL (Extraction, Transportation, transformation and loading), Server, Data warehouse architecture.

I. INTRODUCTION

Different people have different definitions for a data warehouse. The most popular definition came from "Bill Inmon", who provided the following:

A data warehouse is a subject-oriented, integrated, time-variant and non-volatile collection of data in support of management's decision making process.

Subject-Oriented: A data warehouse can be used to analyze a particular subject area. For example, "sales" can be a particular subject.

Integrated: A data warehouse integrates data from multiple data sources. For example, source A and source B may have different ways of identifying a product, but in a data warehouse, there will be only a single way of identifying a product.

Time-Variant: Historical data is kept in a data warehouse. For example, one can retrieve data from 3 months, 6 months, 12 months, or even older data from a data warehouse. This contrasts with a transactions system, where often only the most recent data is kept. For example, a transaction system may hold the most recent address of a customer, where a data warehouse can hold all addresses associated with a customer.

Non-volatile: Once data is in the data warehouse, it will not change. So, historical data in a data warehouse should never be altered.

Ralph Kimball provided a more concise definition of a data warehouse: A data warehouse is a copy of transaction data specifically structured for query and analysis. This is a functional view of a data warehouse. Kimball did not address how the data warehouse is built like Inmon did; rather he focused on the functionality of a data warehouse.

Data warehousing is a collection of decision support technologies, aimed at enabling the knowledge worker (executive, manager, analyst) to make better and faster decisions. Data warehousing technologies have been successfully deployed in many industries: manufacturing (for order shipment and customer support), retail (for user profiling and inventory management), financial services (for claims analysis, risk analysis, credit card analysis, and fraud detection), transportation (for fleet management), telecommunications (for call analysis and fraud detection), utilities (for power usage analysis), and healthcare (for outcomes analysis). This paper presents a roadmap of data warehousing technologies, focusing on the special requirements that data warehouses place on database management systems (DBMSs).

II. DATA WAREHOUSING

2.1 Definition of data warehousing:

A single, complete and consistent store of data obtained from a variety of different sources made available to end users in what they can understand and use in a business context.

Data Warehousing is defined in many different ways, but not rigorously.

A decision support database that is maintained separately from the organization's operational database Support information processing by providing a solid platform of consolidated, historical data for analysis. Data warehousing is the process of constructing and using data warehouses. Organized around major

subjects, such as customer, product, sales. Focusing on the modeling and analysis of data for decision makers, not on daily operations or transaction processing. Provide a simple and concise view around particular subject issues by excluding data that are not useful in the decision support process. A data warehouse draws data from operational systems, but is physically separate and serves a different purpose. Operational systems have their own databases and are used for transaction processing; a data warehouse has its own database and is used to support decision making. Once the warehouse is created, users (e.g., analysts, managers) access the data in the warehouse using tools that generate SQL (i.e., structured query language) queries or through applications such as a decision support system or an executive information system. "Data warehousing" is a broader term than "data warehouse" and is used to describe the creation, maintenance, use, and continuous refreshing of the data in the warehouse.

2.2 Explains how to design and manage data warehouse systems focusing on project management aspects:

They give an overview of organizational roles involved in a typical data warehouse project. Meyer (2000) and Meyer/Winter (2001) present organizational requirements for data warehousing and the concept of data ownership. A two-dimensional organizational structure for large financial service companies combining infrastructural competencies and content competencies is derived. Auth (2003) develops a process-oriented organizational concept for metadata management providing detailed activity chains and organizational roles. As shown above the organizational domain of data warehouse systems still lacks attention of data warehouse researchers compared to technical aspects. Therefore this paper aims at providing deeper insights in the current organizational situation of data warehouse departments in practice. The organizational domain of companies can be divided in a structural, human resource, political, and symbolic dimension and each dimension requires different design instruments (Bolman/Deal 2003, Mueller-Stewens 2003). The structural dimension focuses on goals, formal roles and relationships. Structures are created to achieve the company's goals considering technological and environmental factors. Rules, policies, processes, and hierarchies are the design elements of the structural dimension. Drawing from psychology, the human resource dimension takes care about the needs, feelings, prejudices, and limitations of all individuals. The political dimension sees organizations as arenas. Different interest groups cause conflicts while competing for power and resources and the organizational life is characterized by bargaining, negotiations and compromises. The OLAP Council (<http://www.olapcouncil.org>) is a good source of information on standardization efforts across the industry. The symbolic dimension abandons the assumptions of rational behavior and views organizations as some kind of theatres. Finally, a good source of references on data warehousing and OLAP is the Data Warehousing Information Center.

2.3 Data warehouse Architecture

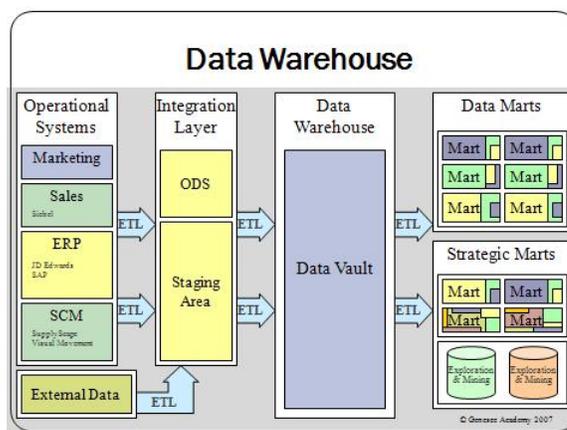


Fig: 1 shows a Data warehousing architecture

It includes tools for extracting data from multiple operational databases and external sources; for cleaning, transforming and integrating this data; for loading data into the data warehouse; and for periodically refreshing the warehouse to reflect updates at the sources and to purge data from the warehouse, perhaps onto slower archival storage. In addition to the main warehouse, there may be several departmental data marts. Data in the warehouse and data marts is stored and managed by one or more warehouse servers, which present multidimensional views of data to a variety of front end tools: query tools, report writers, analysis tools, and data mining tools. Finally, there is a repository for storing and managing metadata, and tools for monitoring and administering the warehousing system.

Enterprise warehouse collects all of the information about subjects spanning the entire organization

Data Mart is a subset of corporate-wide data that is of value to a specific groups of users. Its scope is confined to specific, selected groups, such as marketing data mart

Independent vs. dependent (directly from warehouse) data mart.

Virtual warehouse is a set of views over operational databases

Only some of the possible summary views may be materialized.

Meta data is the data defining warehouse objects. It stores Description of the structure of the data warehouse schema, view, dimensions, hierarchies, derived data defined, data mart locations and contents

Operational meta-data is a data lineage (history of migrated data and transformation path), currency of data (active, archived, or purged), monitoring information (warehouse usage statistics, error reports, audit trails)

The algorithms used for summarization and the mapping from operational environment to the data warehouse data related to system performance Warehouse schema, view and derived data definitions.

III. OLTP AND OLAP

The job of earlier on-line operational systems was to perform transaction and query processing. So, they are also termed as on-line transaction processing systems (OLTP). Data warehouse systems serve users or knowledge workers in the role of data

analysis and decision-making. Such systems can organize and present data in various formats in order to accommodate the diverse needs of the different users. These systems are called on-line analytical processing (OLAP) systems.

3.1 Major distinguishing features between OLTP and OLAP

- i) Users and system orientation: OLTP is customer-oriented and is used for transaction and query processing by clerks, clients and information technology professionals. An OLAP system is market-oriented and is used for data analysis by knowledge workers, including managers, executives and analysts.
- ii) Data contents: OLTP system manages current data in too detailed format. While an OLAP system manages large amounts of historical data, provides facilities for summarization and aggregation. Moreover, information is stored and managed at different levels of granularity, it makes the data easier to use in informed decision-making.
- iii) Database design: An OLTP system generally adopts an entity-relationship data model and an application-oriented database design. An OLAP system adopts either a star or snowflake model and a subject oriented database design.

IV. DATA MINING

Data Mining is the extraction or “Mining” of knowledge from a large amount of data or data warehouse. To do this extraction data mining combines artificial intelligence, statistical analysis and database management systems to attempt to pull knowledge from stored data. Data mining is the process of applying intelligent methods to extract data patterns. This is done using the front-end tools. The spreadsheet is still the most compiling front-end application for Online Analytical Processing (OLAP).

- The automatic discovery of relationships in typically large database and, in some instances, the use of the discovery results in predicting relationships.
- An essential process where intelligent methods are applied in order to extract data patterns.
- Data mining lets you be proactive
 - Prospective rather than Retrospective

1.1 Why mine data?

Commercial viewpoint...

- Lots of data is being collected and warehoused.
- Computing has become affordable.
- Competitive Pressure is Strong
 - Provide better, customized services for an edge.
 - Information is becoming product in its own right.

1.2 Why Mine Data?

Scientific Viewpoint...

- Data collected and stored at enormous speeds
 - Remote sensor on a satellite
 - Telescope scanning the skies
 - Microarrays generating gene expression data
 - Scientific simulations generating terabytes of data
- Traditional techniques are infeasible for raw data
- Data mining for data reduction
 - Cataloging, classifying, segmenting data
 - Helps scientists in Hypothesis Formation.

4.3 Major Data Mining Tasks

- Classification: Predicting an item class.
- Association Rule Discovery: descriptive.
- Clustering: descriptive, finding groups of items.
- Sequential Pattern Discovery: descriptive.
- Deviation Detection: predictive, finding changes.
- Forecasting: predicting a parameter value
- Description: describing a group.
- Link analysis: finding relationships and associations.

4.3.1 Classification: Definition

- Given a collection of records(training set)
 - Each record contains a set of attributes, one of the attributes is the class.
- Find a model for class attribute as a function of the values of other attributes.
- Goal: previously unseen records should be assigned a class as accurately as possible.
 - A test set is used to determine the accuracy of the model. Usually, the given data set is divided into training and test sets, with training set used to build the model and test set used to validate it.

4.3.1.1 Classification: Application

- Direct Marketing
 - Goal: Reduce cost of mailing by targeting a set of customers likely to buy a new cell-phone product.
 - Approach:
 - Use the data for a similar product introduced before.
 - We know which customers decided to buy and which decided otherwise. This {buy, don't buy} decision forms the class attribute.
 - Collect various demographic, lifestyle, and company-interaction related information about all such customers.
 - Type of business, where they stay, how much they earn, etc.
 - Use this information as input attributes to learn a classifier model.

4.3.1.2 Associations

- $I = \{i_1, i_2, \dots, i_m\}$: a set of literals, called items.
- Transaction d : a set of items such that $d \subseteq I$
- Database D : a set of transactions
- A transaction d contains X , a set of some items in I , if $X \subseteq d$.
- An association rule is an implication of the form $X \Rightarrow Y$, where $X, Y \subseteq I$.

4.3.1.3 Association rules

- Used to find all rules in a basket data
- Basket data also called transaction data
- analyze how items purchased by customers in a shop are related
- discover all rules that have:-
 - support greater than min sup specified by user
 - confidence greater than min conf specified by user
- Example of transaction data:-
 - CD player, music's CD, music's book
 - CD player, music's CD
 - music's CD, music's book
 - CD player
- Let $I = \{i_1, i_2, \dots, i_m\}$ be a total set of items
 D a set of transactions
 d is one transaction consists of a set of items
 - $d \subseteq I$
- Association rule:-
 - Let $I = \{i_1, i_2, \dots, i_m\}$ be a total set of items
 - D a set of transactions
 - d is one transaction consists of a set of items
 - $d \subseteq I$

Association rule:-

- $X \Rightarrow Y$ where $X \subseteq I, Y \subseteq I$ and $X \cap Y = \emptyset$
- support = $(\# \text{of transactions contain } X \cup Y) / D$
- confidence = $(\# \text{of transactions contain } X \cup Y) / \# \text{of transactions contain } X$.

4.3.1.4 Clustering

- Given a set of data points, each having a set of attributes, and a similarity measure among them, find clusters such that
 - Data points in one cluster are more similar to one another.
 - Data points in separate clusters are less similar to one another.

4.3.1.4 Clustering Applications

- Market Segmentation:
 - Goal: subdivide a market into distinct subsets of customers where any subset may conceivably be selected as a market target to be reached with a distinct marketing mix.
- Approach:
 - Collect different attributes of customers based on their geographical and lifestyle related information
 - Find clusters of similar customers.
 - Measure the clustering quality by observing buying patterns of customers in same cluster vs. those from different clusters.

V. BAYESIAN BELIEF NETWORKS

Bayesian belief network (also known as Bayesian network, probabilistic network): allows class conditional independencies between subsets of variables

- Two components: (1) A directed acyclic graph (called a structure) and (2) a set of conditional probability tables (CPTs).
- A (directed acyclic) graphical model of causal influence relationships.
- Represents dependency among the variables.
- Gives a specification of joint probability distribution.

1.3 How Are Bayesian Networks Constructed?

- **Subjective construction:** Identification of (direct) causal structure.
 - People are quite good at identifying direct causes from a given set of variables & whether the set contains all relevant direct causes.
 - Markovian assumption: Each variable becomes independent of its non-effects once its direct causes are known
 - E.g., $S \leftarrow F \rightarrow A \leftarrow T$, path $S \rightarrow A$ is blocked once we know $F \rightarrow A$
 - HMM (Hidden Markov Model): often used to model dynamic systems whose states are not observable, yet their outputs are:
 - **Synthesis from other specifications**
- E.g., from a formal system design: block diagrams & info flow
- **Learning from data**
- E.g., from medical records or student admission record.
- Learn parameters give its structure or learn both structure and parms
 - Maximum likelihood principle: favors Bayesian networks that maximize the probability of observing the given data set.

5.2 Training Bayesian Networks: Several Scenarios.

- Scenario 1: Given both the network structure and all variables observable: *compute only the CPT entries*
- Scenario 2: Network structure known, some variables hidden: *gradient descent* (greedy hill-climbing) method, i.e., search for a solution along the steepest descent of a criterion function
- Weights are initialized to random probability values
- At each iteration, it moves towards what appears to be the best solution at the moment, w.o. backtracking
- Weights are updated at each iteration & converge to local optimum
- Scenario 3: Network structure unknown, all variables observable: search through the model space to *reconstruct network topology*.
- Scenario 4: Unknown structure, all hidden variables: No good algorithms known for this purpose
- D. Heckerman. [A Tutorial on Learning with Bayesian Networks](#). In Learning in Graphical Models, M. Jordan, ed. MIT Press, 1999.

1.4 Neuron: A Hidden/Output Layer Unit

Fig: 2 Hidden/output layer diagram

For Example

$$y = \text{sign}\left(\sum_{i=0}^n w_i x_i - \mu_k\right)$$

- An n -dimensional input vector \mathbf{x} is mapped into variable y by means of the scalar product and a nonlinear function mapping

The inputs to unit are outputs from the previous layer. They are multiplied by their corresponding weights to form a weighted sum, which is added to the bias associated with unit. Then a nonlinear activation function is applied to it.

1.5 Genetic Algorithms (GA)

- Genetic Algorithm: based on an analogy to biological evolution
- An initial population is created consisting of randomly generated rules
- Each rule is represented by a string of bits
- E.g., if A_1 and $\neg A_2$ then C_2 can be encoded as 100
- If an attribute has $k > 2$ values, k bits can be used
- Based on the notion of survival of the fittest, a new population is formed to

consist of the fittest rules and their offspring

- The fitness of a rule is represented by its classification accuracy on a set of training examples
- Offspring are generated by crossover and mutation
- The process continues until a population P evolves when each rule in P satisfies a pre-specified threshold
- Slow but easily parallelizable.

5.4.1 Rough Set Approach:

- Rough sets are used to approximately or “roughly” define equivalent classes
- A rough set for a given class C is approximated by two sets: a lower approximation (certain to be in C) and an upper approximation (cannot be described as not belonging to C)
- Finding the minimal subsets (**reducts**) of attributes for feature reduction is NP-hard but a **discernibility matrix** (which stores the differences between attribute values for each pair of data tuples) is used to reduce the computation intensity.

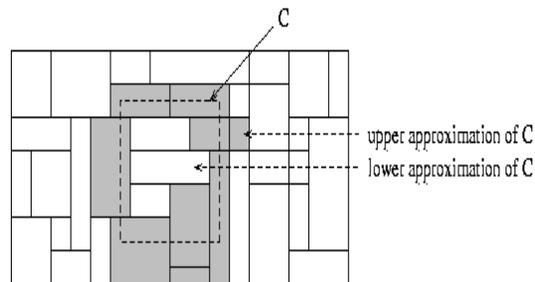


Fig: 3 rough set Approach

VI. ACTIVE LEARNING

- Class labels are expensive to obtain
- Active learner: query human (oracle) for labels
- Pool-based approach: Uses a pool of unlabeled data
 - L : a small subset of D is labeled, U : a pool of unlabeled data in D
 - Use a query function to carefully select one or more tuples from U and request labels from an oracle (a human annotator)
 - The newly labeled samples are added to L , and learn a model
 - Goal: Achieve high accuracy using as few labeled data as possible
- Evaluated using learning curves: Accuracy as a function of the number of instances queried (# of tuples to be queried should be small)
- Research issue: How to choose the data tuples to be queried?

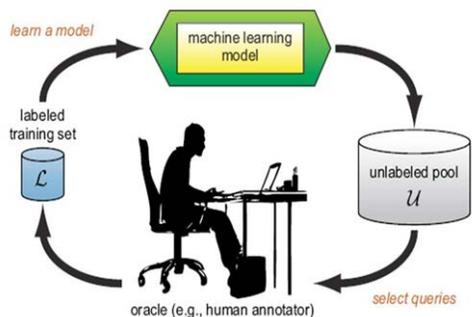


Fig: 7 Rough set Approach

- Uncertainty sampling: choose the least certain ones
- Reduce *version space*, the subset of hypotheses consistent w. the training data
- Reduce expected entropy over U: Find the greatest reduction in the total number of incorrect predictions.

VII. TRANSFER LEARNING: CONCEPTUAL FRAMEWORK

- Transfer learning: Extract knowledge from one or more source tasks and apply the knowledge to a target task
- Traditional learning: Build a new classifier for each new task
- Transfer learning: Build new classifier by applying existing knowledge learned from source tasks.

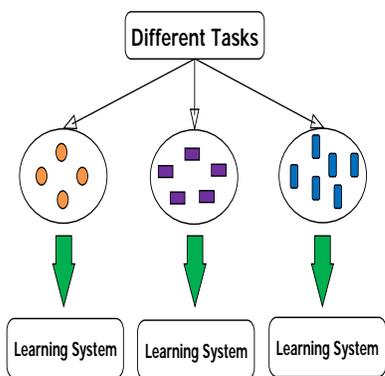


Fig: 8 Traditional Learning Framework

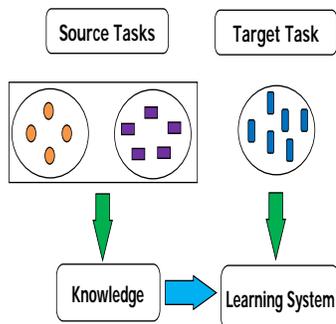


Fig: 9 Transfer Learning Framework

VIII. A CLOSER LOOK AT CMAR

- **CMAR** (Classification based on Multiple Association Rules: Li, Han, Pei, ICDM'01)
- **Efficiency**: Uses an enhanced FP-tree that maintains the distribution of class labels among tuples satisfying each frequent itemset
- **Rule pruning** whenever a rule is inserted into the tree
 - Given two rules, R_1 and R_2 , if the antecedent of R_1 is more general than that of R_2 and $\text{conf}(R_1) \geq \text{conf}(R_2)$, then prune R_2
 - Prunes rules for which the rule antecedent and class are not positively correlated, based on a χ^2 test of statistical significance
- **Classification** based on generated/pruned rules
 - If only *one rule* satisfies tuple X, assign the class label of the rule
 - If a *rule set S* satisfies X, CMAR
 - divides S into groups according to class labels
 - uses a weighted χ^2 measure to find the strongest group of rules, based on the statistical correlation of rules within a group
 - assigns X the class label of the strongest group.

REFERENCES

- [1] C. M. Bishop, Neural Networks for Pattern Recognition. Oxford University Press, 1995
- [2] C. J. C. Burges. A Tutorial on Support Vector Machines for Pattern Recognition. Data Mining and Knowledge Discovery, 2(2): 121-168, 1998
- [3] H. Cheng, X. Yan, J. Han, and C.-W. Hsu, Discriminative Frequent pattern Analysis for Effective Classification, ICDE'07
- [4] H. Cheng, X. Yan, J. Han, and P. S. Yu, Direct Discriminative Pattern Mining for Effective Classification, ICDE'08
- [5] N. Cristianini and J. Shawe-Taylor, Introduction to Support Vector Machines and Other Kernel-Based Learning Methods, Cambridge University Press, 2000
- [6] A. J. Dobson. An Introduction to Generalized Linear Models. Chapman & Hall, 1990
- [7] G. Dong and J. Li. Efficient mining of emerging patterns: Discovering trends and differences. KDD'99
- [8] R. O. Duda, P. E. Hart, and D. G. Stork. Pattern Classification, 2ed. John Wiley, 2001
- [9] T. Hastie, R. Tibshirani, and J. Friedman. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Springer-Verlag, 2001
- [10] S. Haykin, Neural Networks and Learning Machines, Prentice Hall, 2008
- [11] D. Heckerman, D. Geiger, and D. M. Chickering. Learning Bayesian networks: The combination of knowledge and statistical data. Machine Learning, 1995.
- [12] V. Kecman, Learning and Soft Computing: Support Vector Machines, Neural Networks, and Fuzzy Logic, MIT Press, 2001
- [13] W. Li, J. Han, and J. Pei, CMAR: Accurate and Efficient Classification Based on Multiple Class-Association Rules, ICDM'01
- [14] T.-S. Lim, W.-Y. Loh, and Y.-S. Shih. A comparison of prediction accuracy, complexity, and training time of thirty-three old and new classification algorithms. Machine Learning, 2000

AUTHORS

First Author – AMANDEEP KOUR, Assistant Professor,
“Department of Computer Science and Engineering”, M.B.S

College of Engineering & Technology, Babilia, Jammu (J&K)
India, amandeepkour607@gmail.com

sAnalysis of Causes of Physical Domestic Violence against Women in Huye District of Rwanda

Ntegereze Peter

Department of Applied Statistics, College of Business and Economics, University of Rwanda

Kigali, Rwanda

Abstract-Physical domestic violence has been significant issues for centuries in all countries. Women's rights are violated in myriad ways in the private sphere these include, the continued practice of harmful cultural practices and other forms of physical domestic violence.

The aim of this paper: The aim of the research was to analyze the causes of physical domestic violence against women in Huye district of Rwanda.

Hypothesis: This research has tested the relationship between types and the causes of physical domestic violence.

Materials and methods: Data were collected using android mobile phone with application of KoBo collect as the best quicker tool superior to paper based. A number of 120 respondents were selected proceeding snowball technique from two sectors of Huye district sampled by multistage sampling procedure with two stages, this method was employed due to it reduces cost and lessen the impossibility of getting list of respondents units.

Results: Findings revealed a positive relationship between types and causes of physical domestic violence and drunkenness heads the list of those causes where slapping is a frequent abused led by drunkenness and it was advocated to sensitize human rights, to make dialogue with partners, to control alcohol and drug use and fixing serious punishment as measures to eliminate physical domestic violence against women.

Conclusion: In nutshell, as findings pointed out that types of physical domestic violence vary positively with causes where drunkenness is the most cause of physical domestic violence against women mainly slapping them.

The research suggested that dialogue, sensitization of human rights, controlling consumption of alcohol and drugs' use and fixing punishment should be the essential weapons to curb physical domestic violence against women.

Index Terms- Violence, Domestic violence, Physical domestic violence (PDV), Types and Causes of PDV

I. INTRODUCTION

Physical domestic violence against women is major public health problems and violations of women's human rights. Physical domestic violence is the most common form of violence occurring in every society in the world. Not long ago, what happened within the home was considered to be a private, family matter and was excluded from scrutiny by the public. Physical domestic violence not only affects those who are abused, but also

has a substantial effect on family members, friends, co-workers, other witnesses, and the community at large. Children, who grow up witnessing physical domestic violence, are among those seriously affected by this abuse. Frequent exposure to physical domestic violence in the home not only predisposes women to numerous social and physical problems, but also teaches them that violence is a normal way of life. Physical domestic violence against women is a global problem without cultural, geographic, religious, social, economic or national boundaries. It is considered one of the most serious violations of human rights and is a widespread phenomenon which does not discriminate based on race, religion, ethnicity or language. Violence against women as a social and health problem mostly within close/immediate social settings has serious consequences affecting not only female victims' physical and emotional health, and social well-being, but has considerable effects on children, family and society as whole (Marine Chitashvili, Nino Javakhishvili, Luiza Arutiunov, Lia Tsuladze, & Sophio Chachanidze, 2010).

Physical domestic violence against women deprives them of their right to participate in societal life as a whole and holds them prisoners under the special conditions set by the immediate social setting such as family, kinship, social norms and values shared by the majority. The practice of violence against women and particularly physical domestic violence is a constant variable that deviates depending on societal vectors like social and economic development of the country as well as the societal norms perceived as a "normal" for the current culture of the nation-state. The major impact physical domestic violence has on women is hindering their full inclusion and participation in social life and of course wellbeing of healthy nation. Combating physical domestic violence is important for building a truly democratic society founded on the principles of human rights (Marine Chitashvili et al., 2010).

Recent global prevalence figures indicate that 35% of women worldwide have experienced intimate partner violence or non-partner sexual violence in their lifetime.

On average, 30% of women who have been in a relationship report that they have experienced some form of physical or sexual violence by their partner, globally, as many as 38% of murders of women are committed by an intimate partner (World health organization, 2013).

In Rwanda, approximately two in five women (41 percent) have experienced physical violence since age 15. The proportion of women who have ever experienced physical violence increases with the age of women, from 16 percent (age 15-19) to 58 percent (age 40-49).

Women who are employed for cash are more likely to report having experienced physical violence compared with women who are unemployed or employed but not paid in cash. Formerly married women (divorced, separated, or widowed) are more likely to have ever experienced physical violence since age 15 than currently married and never married women (70 percent, compared with 56 and 14 percent, respectively). Women with no living children are least likely to have experienced physical violence since age 15 (17 percent) (National Institute of Statistics of Rwanda, 2010).

There is little variation in the level of physical violence by urban-rural residence and by province. The percentage of women who have ever experienced physical violence ranges from 35 percent in the city of Kigali to 46 percent in the East province.

The proportion of women who have ever experienced physical violence declines steeply with education, from 53 percent of women with no education to 24 percent of women with secondary and higher education. Women's experience of physical violence is highest in the lowest wealth quintile (49 percent), and is lowest in the highest wealth quintile (33 percent); however, the relationship is not linear (National Institute of Statistics of Rwanda, 2010).

Among women who have ever experienced physical violence by current marital status, 95 percent reported that a current husband or partner committed the physical violence against them. And among women who have never been married, the most common perpetrators of physical violence are neighbor/community member (22 percent), sister/brother (17 percent), father/stepfather (16 percent), and mother/stepmother (14 percent) (National Institute of Statistics of Rwanda, 2010).

The causes of physical domestic violence have grounded in various ways. Laws on physical domestic violence vary by country, while it is generally outlawed in the Western World; this is not the case in many developing countries. The social acceptability of physical domestic violence differs by country while in most developed countries physical domestic violence is considered unacceptable by most people; in many regions of the world the views are different.

Refusing to submit to a husband's wishes is a common reason given for justification of violence in developing countries (Measure DHS, 2013) for instance 62.4% of women in Tajikistan justify wife beating if the wife goes out without telling the husband; 68% if she argues with him; 47.9% if she refuses to have sex with him (World health organization, 2013). Traditionally, in most cultures, men had a legal right to use physical domestic violence to "discipline" their wives (World health organization, 2013).

It was from this focus the ideas of conducting this research germinated with intention to analyze the causes of various types of physical domestic violence against women in Huye district of Rwanda and to suggest suitable measures for reducing the occurrence and prevalence of physical domestic violence.

II. METHODOLOGY

Research design: This research has used a combination of three research design to reach objectives of the whole undertaking. According to Kothari (2005) no single research design can solely be sufficient for a whole research process.

This research has adopted case study design; due to case study is an in-depth study of a particular research problem rather than a sweeping statistical survey. It was useful to narrow down a very broad field of research into one or a few easily researchable examples (C.R. Kothari, 2005). The case study research design is also useful for testing whether a specific theory and model actually applies to phenomena in the real world. It is a useful design when not much is known about a phenomenon. The researcher also adopted an ex post facto as his research design in that there is no control or treatment of variables required (C.R. Kothari, 2005). An ex-post facto research design is one which does not involve experimentation. It is also a cross-sectional study where a cross-sectional study analyzes data at one time point, and thus does not consider future or past periods (Chava, James L. Bellini, & L. Robert McConnell, 2005).

Source of data: This study has mainly used primary data gathered from respondents who experienced domestic physical violence in Huye district

Target population: For the success of the study, information to be representative of the population covered by the research questions, researcher took case study of households in Huye district of Rwanda. This was in accordance with Chava opinion stating that population refers to the total number of elements covered by the research questions (Chava et al., 2005).

Sample size: According to Depelteau (2000) most methodological manuals in human sciences recommend that a sample must represent at least 10% of the size of the study population.

The same manuals recommend a minimum of 30 units for a sample. And this research has conducted survey on 120 respondents.

Ten percent of our study population which is of 77,915 households (National Institute of Statistics of Rwanda, 2014) would bring us therefore to a sample of about 7,792 individuals, which is unrealistic considering the financial and time constraints. Nevertheless, our sample of 120 individuals remains in the limits of a representative sample, acceptable and even recommended.

Sampling techniques: To succeed representative sample, research have used multistage sampling. Multistage sampling was generally used because it is lessened the cost and lightened the impossibility to form a list of all the units in the target population. A multi-stage sample is often more precise than a simple random sample of the same cost (Nathaniel Bell et al., 2012), and it is for this reason that the method was employed. The study population was selected in two stages, the first stage, 2 sectors (also known as clusters or enumeration areas) was selected randomly; basically Huye district comprises 14 sectors and researcher economically selected two sectors randomly as representing clusters of Huye district and the second stage comprised of the households. From these two stages, the researcher used both simple random and snow ball sampling techniques as these enabled him to select respondents who could provide him with the information needed for the study (Browne & Kath, 2005).

Data collection methods and tools: The information from the primary data was obtained through a structured questionnaire loaded in KoBo Collect (Mobile Phone Application for Android Smart Phones) as data collection tool.

KoBo Toolbox provides an integrated suite of applications for data collection. This collection tool is superior to paper-based methods in terms of speed, data quality, and security, and is a cost-effective alternative to manual data entry (Radio La Benevolencija, 2013). Researcher used the Form Builder to design surveys that run in the KoBo Collect application for Android devices. The survey contained many kinds of questions, including text or numerical input, multi-select, single-select.

Data processing and analytical methods: Data processing was done in accordance with general and specific objectives of the research study.

After carrying out interviews with respondents' there was editing and the information was arranged in a meaningful and organized form by coding it according to a pre-designed coding manual aid keyed into the Computer in a spreadsheet, the coded variables were then summarized into frequencies and statistical diagrams and charts used for the presentation.

Univariate analysis was used to find summary statistics and frequency table, bivariate analysis was used to find relationship among variables and spearman correlation analysis was used to find the strengths of effects of causes on types of physical domestic violence. Spearman correlation was used to indicate the direction and strengths of coefficients. Spearman correlation is a nonparametric measure of statistical dependence between two variables. It assesses how well the relationship between two variables can be described using monotonic function. Spearman's coefficient ρ , like any correlation calculation, is appropriate for both continuous and discrete variables, including ordinal variables (Myers, Jerome L, Well, & Arnold D., 2003). And ρ is computed from:

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

Where $d_i = x_i - y_i$, is the difference between ranks.

The model should be $Y = \alpha X$ where Y is type of violence; X is the cause of physical domestic violence and α is the intensity of

effect of causes on a type of violence. This was afforded through the statistical package for social scientists (SPSS).

III. RESULTS

Findings in this paper came from socio-demographic profile of women age 25-59 who responded to the research questions with respect to the causes of physical domestic violence against women in Rwanda.

Types of physical domestic violence and major perpetrators

This section presents types of physical domestic violence, perpetrators and the scale of occurrence of physical domestic violence presented in various forms and perpetrators vary from type to type and also occurrence depends upon the type, hence this section discussed types of physical domestic violence, perpetrators and the scale of occurrence of physical domestic violence.

Types of physical domestic violence against women

The major types of physical domestic violence observed in the data collected in the study site include pushing/shaking/throwing (objects), slapping, twisting arm/pulling hair, punching with fist, kicking/dragging/beating up, choking/burning, threatening/attacking with weapon and other namely sexual/rape.

Table1. presents that nearly 12 percent reported that they experienced violence of pushing/shaking/throwing (objects), slightly more than 24 percent reported that they experienced violence of slapping, slightly more than 13 percent reported that they experienced violence of twisting arm/pulling hair, nearly 11 percent reported that they experienced violence of punching with fist, slightly more than 23 percent reported that they experienced violence of kicking/dragging/beating up, slightly more than 8 percent reported that they experienced violence of choking/burning, nearly 3 percent reported that they experienced violence of threatening/attacking with weapon and nearly 6 percent reported that they experienced violence of other physical domestic violence and they pointed out sexual/rape.

Table 1. Types of physical domestic violence

Types of the physical domestic violence	Frequency (%)
Pushing/shaking/throwing (objects)	14(11.7)
Slapping	29(24.2)
Twisting arm/pulling hair	16(13.3)
Punching with fist	13(10.8)
Kicking/dragging/beating up	28(23.3)
Chocking/burning	10(8.3)
Threatening/attacking with weapon	3(2.5)
Other	7(5.8)
Total	120(100)

Source: Primary data

Major perpetrators of physical domestic violence against women

Overall, men are the major perpetrators of all types of violence according to the study. As displayed in Table 2 below, men were cited as being the major perpetrators of physical

domestic violence by the overwhelming majority of respondents at slightly more than 84 percent. The respondents who cited workers (domestic workers) as perpetrators of violence were nearly 6 percent while those who mentioned other as perpetrators accounted for 10 percent.

Table 2. Perpetrators of physical domestic violence

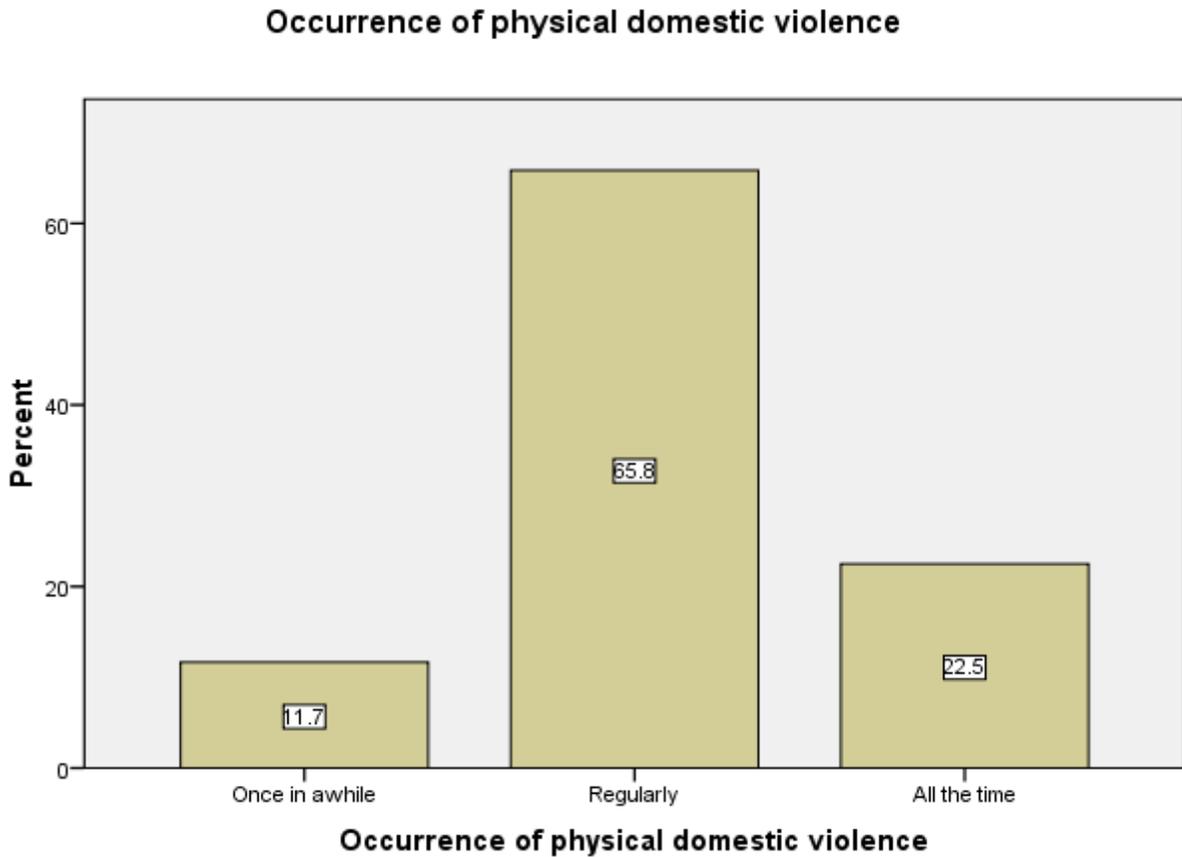
Perpetrators of physical domestic violence			
Types of the physical domestic violence	Husband Frequency (%)	Worker Frequency (%)	Other Frequency (%)
Pushing/shaking/throwing (objects)	9(7.5)	1(0.8)	4(3.3)
Slapping	29(24.2)	0(0.0)	0(0.0)
Twisting arm/pulling hair	16(13.3)	0(0.0)	0(0.0)
Punching with fist	12(10.0)	1(0.8)	0(0.0)
Kicking/dragging/beating up	27(22.5)	1(0.8)	0(0.0)
Chocking/burning	8(6.7)	2(1.7)	0(0.0)
Threatening/attacking with weapon	0(0.0)	1(0.8)	2(1.7)
Other	0(0.0)	1(0.8)	6(5.0)
Total	101(84.2)	7(5.8)	12(10.0)

Source: Primary data

Scale of occurrence of physical domestic violence

In order to know the scale of types of violence respondents were asked to mention how many times such type of violence took place. Figure 1 shows the responses obtained.

Figure1. The scale of occurrence of physical domestic violence



Source: Primary data

Figure 1 presents the scale of occurrence of physical domestic violence. The research revealed that majority of respondents' experienced regularly domestic violence. Indeed pointed out by nearly 66 percent. Nearly 23 faced all the time physical domestic violence and nearly 12 percent of women experienced domestic violence once in awhile.

Causes of physical domestic violence

The causes of physical domestic violence in the families as identified by respondents are: drunkenness, wickedness, excessive anger, lack of dialogue, drugs, contempt, bad character, accidental events. Based on respondents views these range as presented in the Table 3 below.

Table 3. Causes of domestic violence

Causes of domestic violence	Frequency (%)
Drunkenness	63(52.5)
Excessive anger	15(12.5)
Lack of dialogue	12(10.0)
Wickedness (hatred)	4(3.3)
Drugs	12(10.0)
Contempt	4(3.3)
Bad character	7(5.8)
Ignorance	2(1.7)
Accidental event	1(0.8)

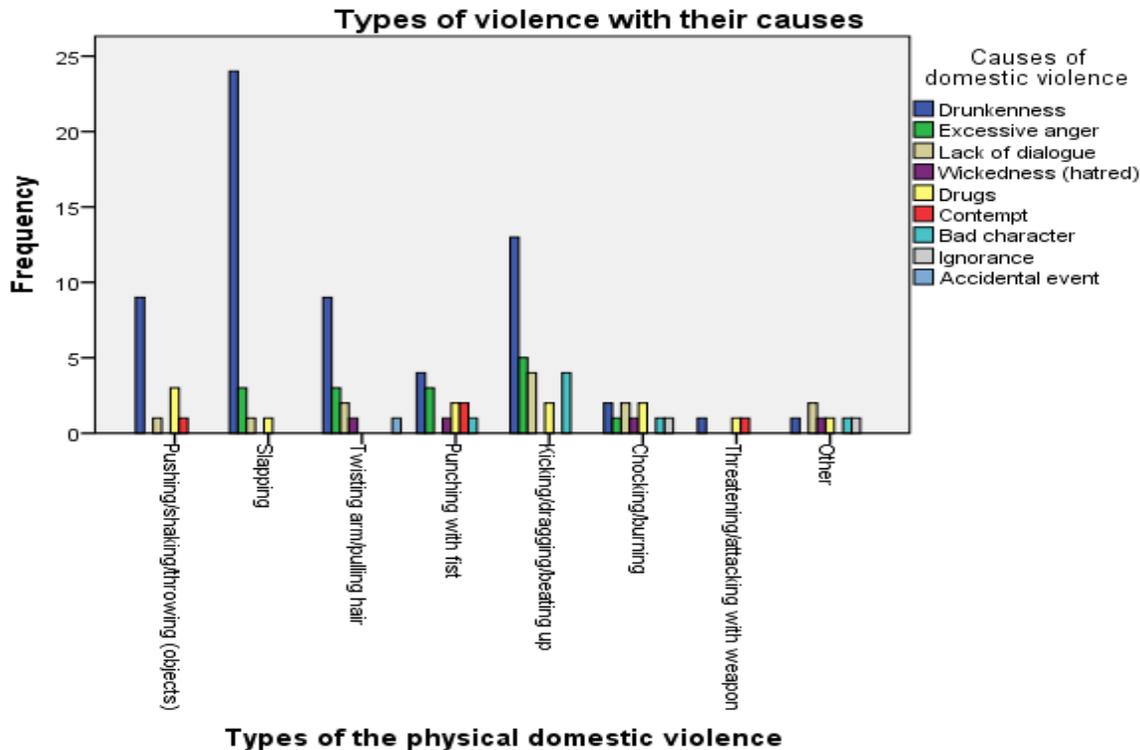
Source: Primary data

Table 3 Shows that drunkenness is heading the list as the most important cause of physical domestic violence to family provided it has been pointed out by most of people if compared to other causes. Indeed, it has been pointed out by nearly 53 percent of respondents. Among those other causes (47 percent), nearly 13 percent reported excessive anger as the cause of violence, 10 percent reported lack of dialogue as the cause of violence, 10 percent reported lack of dialogue as the cause of violence,

10 percent reported drugs as the cause of violence, nearly 6 percent reported bad character as the cause of violence, slightly more than 3 percent reported contempt as the cause of violence. Slightly more than 3 percent reported wickedness as the cause of violence and nearly 1 percent reported accidental events as the cause of violence.

Causes have various effects to influence the incidence and prevalence of a type of physical domestic violence. The figure 4 presents the relationship between types of physical domestic violence and causes of physical domestic violence.

Figure 2. Types of violence with their causes



Source: Primary data

Figure 2 presents that drunkenness is heading the list of major causes of physical domestic violence leading to slapping.

Table 4. Spearman correlation

Correlations				
		Types of the physical domestic violence		Causes of domestic violence
Spearman's rho	Types of the physical domestic violence	Correlation Coefficient	1.000	0.385**
		Sig. (2-tailed)	.	0.000
		N	120	120
	Causes of domestic violence	Correlation Coefficient	0.385**	1.000
		Sig. (2-tailed)	0.000	.
		N	120	120

** . Correlation is significant at the 0.01 level (2-tailed).

Source: Computed from primary data

The Table 4 presents Spearman correlations; spearman correlations show a positive relationship between types and the causes of physical domestic violence. The strength of effect of a cause to a type of physical domestic violence is 0.385. The test shows that there is a significant effect brought by a cause to a type of physical domestic violence. Therefore $Y = 0.385X$ that is an increase of one cause effect affects 0.385 effect of a type being grounded.

The analysis has revealed that drunkenness was heading the list with a lot effects to lead circumstances of slapping physical domestic violence compared to other physical domestic violence forms.

Measures for reducing the incidence and prevalence of physical domestic violence

Every day, millions of women and girls across the world are beaten and abused. Many are harmed in their homes by members of their family or community.

Others are raped or harassed by the very security forces that are meant to protect them. Some victims of gender-based violence are employed outside their homes, some are not. Some are rich, some are poor. Some are literate, some are not. They are mothers, daughters, sisters, and friends. They have only one thing in common: they are female, and they are abused because of it.

On top of views from respondents participated in this research, they pointed out a number of measures for reducing the incidence and prevalence of physical domestic violence against women including: dialogue with partners, sensitization of human rights and fixing serious punishments to those who commit abuses.

IV. CONCLUSION

In nutshell, women as victims of physical domestic violence have become a prevalent issue amongst our present society. Findings revealed that husbands are heading the list of perpetrators of physical domestic violence at the extent of slightly more than 84 percent

The analysis made in purpose of analyzing causes of physical domestic violence in Huye district of Rwanda has put out a number of causes including drunkenness with incidence of nearly 53 percent, nearly 13 percent for excessive anger as the cause of violence, 10 percent is lack of dialogue as the cause of violence, 10 percent for drugs as the cause of violence, nearly 6 percent reported bad character as the cause of violence, slightly more than 3 percent for contempt as the cause of violence, slightly more than 3 percent for wickedness as the cause of violence and nearly 1 percent for accidental events as the cause of violence. Furthermore, the spearman correlation showed a positive relationship that an increase of one cause effect affects 0.385 effect of a type. Furthermore, findings pointed out that types of physical domestic violence vary with causes where drunkenness is the most cause of physical domestic violence against women and this has a significant effect for other causing circumstance on slapping as well.

The research suggested that dialogue, sensitization of human rights, controlling consumption of alcohol and drugs' use

and fixing punishment should be the essential weapons to curb physical domestic violence against women. Although, the research was successfully reached the objective, it has a got a number of limitation. Major problem encountered was data collection tools with limited time span, which the researcher found it was a tiresome work to get the required data. Funding the research was also another problem since transport and material to obtain accurate and sufficient data as well as costs in typing and loading were so costly.

However, using mobile phone helped researcher to minimize time and cost of printing questionnaires and internet tried to solve the problem of loading questionnaire forms in appropriate data collection tool. Due to limited funds, the researcher used snow ball type of sampling to present total population as a possible way to use available financial resources that compiled the research paper.

V. RECOMMENDATIONS

Reviewing the findings this research came up, taking account to positive relation between types and causes of physical domestic violence that causes of physical domestic violence increase the types of physical domestic violence. Therefore, the researcher recommends the following point in order to support policy makers to curb physical domestic violence against women. To Huye district of Rwanda: Researcher recommends preventive measures of sensitizing human rights so that perpetrators get fear to abuse the women. To household members: Research recommends continuous dialogue with partners for any issue arisen in the house to solve it before it hurt partner. To other researchers: Researcher strongly recommends further researches to deepen the research on this subject matter to increase the evidence base and promote the use of the evidence to advocate eradicating physical domestic violence against women. This research did not cover all the corners related to the analysis of causes of physical domestic violence against women in Rwanda, and this is due to that the subject is multidimensional and immense of types varying to the causes. So, it is recommended to go for further scientific researches, books and journals.

ACKNOWLEDGEMENTS

I am grateful to François Niragire; lecturer at University of Rwanda for his unflinching help by proper guidance and effective comments. I would like also to pass my gratitude to the Department of Applied Statistics (DAS), College of Business and Economics (CBE), University of Rwanda (UR) for allowing me to carry out this research and for availing me with some reading books.

REFERENCES

- [1] Brown, & Kath. (2005). Snowball sampling: using social networks to research non heterosexual women, (8).
- [2] C.R. Kothari. (2005). Research methodology; methods & technology. New age international (P) Limited.
- [3] Chava, James L. Bellini, & L. Robert McConnell. (2005). Journal of Applied Rehabilitation Counseling.

- [4] Depelteau F. (2000). La démarche d'une recherche en sciences humaines : De la question de départ communication des résultats. Bruxelles/Québec: Université/Presses Universitaires Laval.
- [5] Marine Chitashvili, Nino Javakhishvili, Luiza Arutiunov, Lia Tsuladze, & Sophio Chachanidze. (2010). National research on domestic violence against women in Georgia. Tbilisi.
- [6] Myers, Jerome L, Well, & Arnold D. (2003). Research Design and Statistical Analysis (2nd ed.). Lawrence Erlbaum.
- [7] Nathaniel Bell, Gilbert Burnham, Abraham Flaxman, William M Weiss, ulie Rajaratnam, & LP Galway. (2012). "A two-stage cluster sampling method using gridded population data, a GIS, and Google EarthTM imagery in a population-based mortality survey in Iraq.
- [8] National Institute of Statistics of Rwanda. (2010). Rwanda Demographic and Health Survey (No. 4). Rwanda.
- [9] National Institute of Statistics of Rwanda. (2014). Rwanda Population and Housing Census.
- [10] Radio La Benevolencija. (2013). Musekweya popularity survey. Rwanda.
- [11] World health organization. (2013). Violence against women.

AUTHORS

First Author – Ntegereze Peter, Phone: +250782373735, Email: ntegeze@gmail.com, Kigali, Rwanda

Institutionalising Community Participation in Watershed Management: A Study of the Inchaban Watershed in the Western Region of Ghana

¹O. D. Mireku, ¹P. K. Acheampong, ¹S. Mariwah, ¹K. Adu-Boahen, & ²A. K. Mensah

¹Department of Geography and Regional Planning, University of Cape Coast, Cape Coast, Ghana

²Department of Geography, Kenyatta University, Nairobi, Kenya

Abstract- Currently, the participatory watershed approach has now become necessary in any developmental activity especially with regards to natural resource management. However, in spite of the numerous advantages of this management approach, there are still major challenges that militate against its successful implementation in most developing countries. This paper explored the need, challenges, and the extent to which the participatory approach has been incorporated into the management of the Inchaban Watershed found in the Western Region of Ghana. Using two non-probability sampling methods: purposive and convenience, a total number of 41 key respondents were selected. With in-depth interviews and focus group discussions guides, information relating to the importance, challenges and the extent of community involvement was solicited from local chiefs, management and user institutions, and individual users in the Inchaban Watershed. The study revealed that the watershed management institutions could not attract the valuable initiatives of the local users in monitoring and evaluation stages because these users were coerced. It is therefore recommended that local communities should be induced to support the conservation of the watershed using public education and workshops organised by the district regulatory institution such as the Forestry Commission, the Environmental Protection Agency and the Mining Commission.

Index Terms- Integrated water management, Environment, Planning, Public participation, Ghana.

I. INTRODUCTION

This article guides a stepwise walkthrough by Experts for writing a successful journal or a research paper starting from inception of ideas till their publications. Research papers are highly recognized in scholar fraternity and form a core part of PhD curriculum. Research scholars publish their research work in leading journals to complete their grades. In addition, the published research work also provides a big weight-age to get admissions in

reputed varsity. Now, here we enlist the proven steps to publish the research paper in a journal.

Over the past decades the word 'participatory' has been incorporated into the vocabulary of governmental and non-governmental organizations (NGOs) programmes both at the level of implementation and research (Rhoades, 1998). Currently, community participation is a basic principle in any developmental activity and natural resource management programmes in most developing countries. It is generally believed to be the right approach currently used in the management of all natural resources: forest and water resources such as lagoons, rivers and watershed (Walker & Carpenter, 2002). Participatory watershed management has been defined as a process which aims at creating community self-supporting systems at various stages that enhance continuity to bring the desired results (Arthur & Moore, 1999).

The preliminary stage in the participatory watershed approach entails identification of the concern institutions which will establish dialogue with local people (Dukes & Firehock, 2001). Subsequent stages involved in the participatory approach include identifying the basic watershed problem to be tackled, and assessment of resources available for project development (Dovers & Dore, 2003). Leach and Sabatier (2002) discovered that participatory watershed planning must go beyond initial implementation of policies; the implementation stage must be followed by a system of monitoring and evaluation so that local people will be able to follow and measure project developments. Sommarstrom (2000) advised that participatory watershed management must provide opportunities to stakeholders to jointly negotiate their interests and set priorities. Cohen and Uphoff (1980) point out that community involvement should include people's participation in decision-making, implementation of programmes, monitoring and evaluation as well as sharing the benefits from development projects. This is what the author calls the participation in the project cycle.

The definition of community involvement in watershed management largely depends on the level of acceptance and understanding of the inhabitants in

communities where watersheds are essentially important asset for livelihood. Arnstein (1969) identified in a five-stage ladder of community participation, the importance of cooperation from watershed management institutions that will induce community initiatives in project development. The Food and Agriculture Organisation (1982) elaborated that peoples' participation is essential to enhance economic and political relationship within wider societies. Kumar and Pretty (2002) have recognised different levels of participation, ranging from passive to active levels, and have concluded that active participation is where and when local people are totally involved in all processes of management. At the moment, Participatory Watershed Management (PWM) is the foremost strategy in natural resource management which improves agricultural lands for livelihood in many developing countries (Johnson & Ravnborg, 2001). For example, in some East African countries such as Kenya and Tanzania, accesses to land for crop cultivation and adherence to common rules in watershed conservation have improved tremendously [Economic and Social Commission for Asia and the Pacific (ESCAP), 1997]. Martin (2008) has enumerated the advantages of participatory watershed management in the Tano South District in Ghana. These were the advantages;

- arresting free-rider behaviour among members,
- mobilising the needed financial and labour resources from communities,
- imposing self-devised sanctions on individual members for resource degradation,
- providing incentives for resource saving, and
- implementing group decisions for equitable resource distribution and environmental protection.

In spite of the advantages of participatory watershed management, there are still major challenges that militate against its successful implementation and evaluation in most rural communities in Ghana. These are: the delay in decision-making, policy formulation, and over reliance on unprofessional ideas from inhabitants of rural communities which sometimes lead to project failures [Food and Agriculture Organisation (FAO), 2009]. It is against this background that this paper sought to answer the following questions using the Inchaban Watershed in the Western Region of Ghana as the unit of investigation.

- To what extent are the local communities involved in the management of the Inchaban Watershed?

- What challenges do the institutions encounter in involving the local communities in the management of the Inchaban Watershed?

II. CONCEPTUAL FRAMEWORK FOR THE STUDY

A number of frameworks have been used to analyse institutional arrangements in watershed management and conservation. They include the Institutional Framework for Watershed Management by the International Institute for Environment and Development (IIED) (Stewart, 1993), the Institutional Framework for Integrated Watershed Management by the Water Resource Commission (2000), the International Union for Conservation of Nature Framework (King, Pizan & Milman, 1993). However, the Institutional Framework for Integrated Watershed Management by the Water Resource Commission (2000) of Ghana has been adopted for this study because it places emphasis on important civil societies which can support project development in local communities. The framework spells out the important roles (cell CG) that communities can play to support the conservation of watersheds. According to the WRC (2000), the active involvement of local communities in important stages such as identification of problem, project design, data collection, policy formulation and implementation, project implementation, monitoring and evaluation, is essential for project success.

The Integrated Watershed Management Framework: IWM-framework

The strength of this concerned framework (Figure 1), the Integrated Watershed Management Framework, is that, it shows institutional elements that permit community involvement or participation [Water Resource Commission (WRC), 2000]. Consequently, the integrated watershed management framework is designed to include the indigenous knowledge of people as an essential component to make natural resource management in general more effective. The framework integrates nature and peoples participation, and thus creates room for both users and managers without limiting access to resource use.

III. STUDY AREA

Location

The Inchaban Watershed is located in the Shama District of the Western Region of Ghana. The size of the watershed is 13,553.80 acres. The climate is dry-humid tropical (Acheampong, 2009), and has a

double maxima rainfall; the main rainfall season lasts from June to early August, and the minor from September to November. The average annual precipitation is 1195mm (Acheampong, 2009). The dry season is short, occurring from December to February. The average annual humidity of the area is high (over 94 percent) and the mean annual temperatures is 29⁰ C. The main vegetation in the watershed consists of woodland savannah near the coast, while a semi deciduous forest occupies the upper courses of streams. Mangroves occur along the southern portion of the watershed. The nature of the climate and vegetation of the district has limited the growth of most local food crops but rather sugar is extensively cultivated. Consequently, mining and charcoal burning activities have absorbed about 45

percent of the active labour force. Many pockets of farming activities occur in communities such as Dwomo, Nyankrom and Ituma whereas charcoal burning activities have been intensified in portions of the watershed at Inchaban. The relief of the study area is undulating, gently sloping towards the coast, and is interspersed with plains in the west. The landscape is characterised by muddy lagoons and marshlands as a result of the undulating topography. The district is drained by River Anakwari. River Anakwari is dammed at Inchaban to supply potable water to Takoradi and its surrounding settlements that include Dwomo, Nyankrom, Ituma, Shama and Yabiw. Drainage in the district is very poor; the area is prone to flooding.

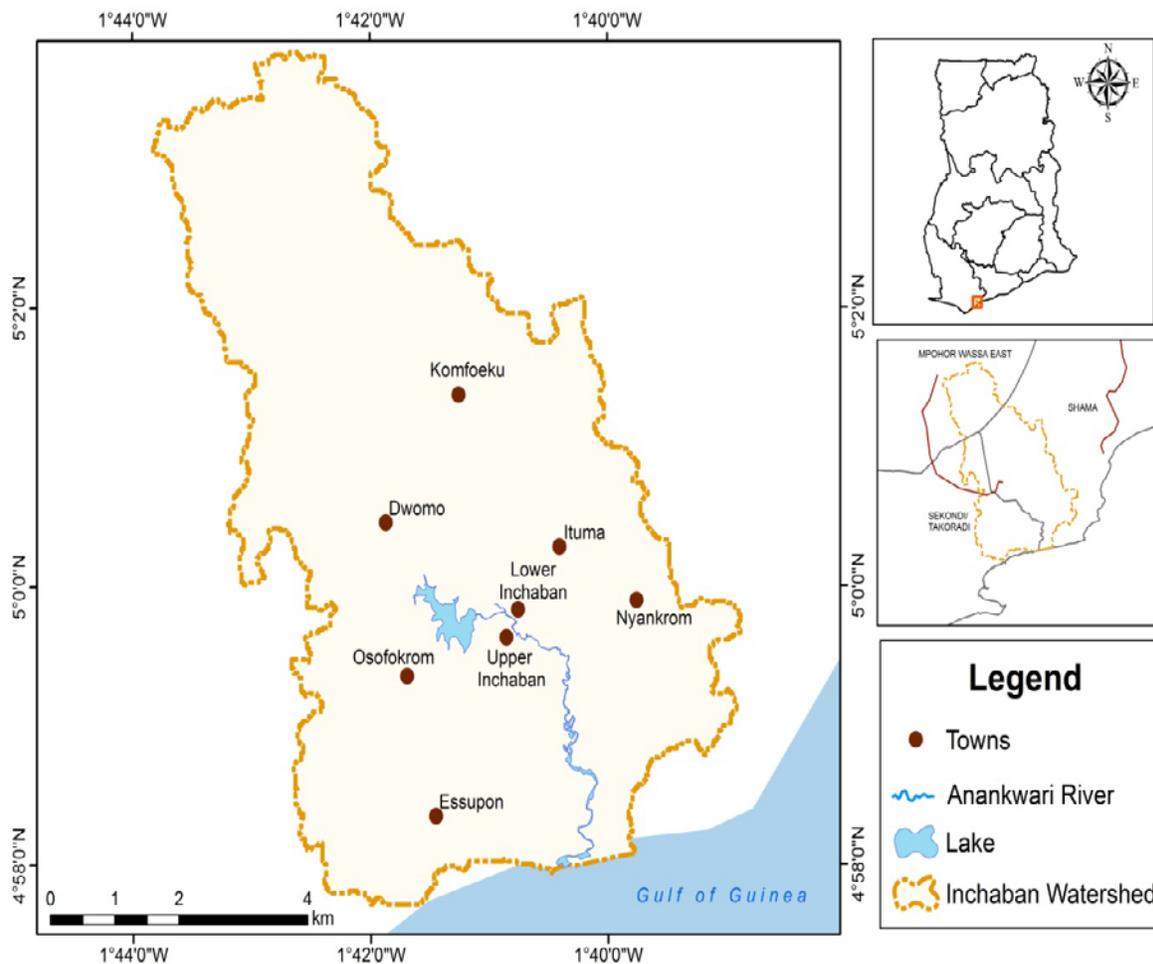


Figure 2: Study area in Regional and National Context

Source: Cartography Unit of the Department of Geography and Regional Planning (UCC), 2011

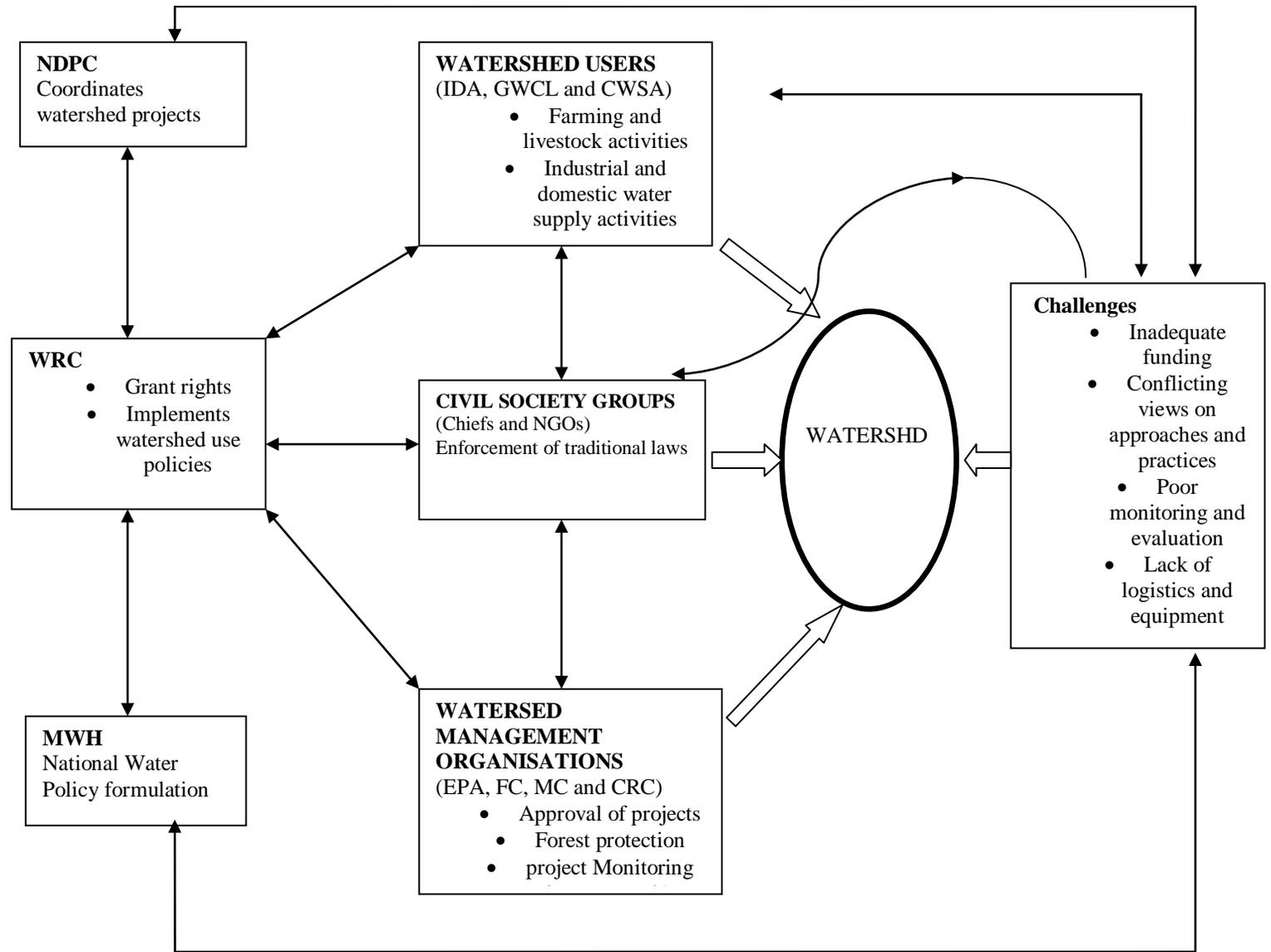


Figure 1: Integrated Watershed Management Framework
Source: Adapted from Ghana Water Resource Commission, 2000

Methodological issues

The study was purely qualitative since it dwelled on in-depth interview guides to solicit information from the respondents. The basic data for analyses in the study was primary data collected from four major groups of stakeholders in the management of the Inchaban Watershed: community chiefs, management institutions, user institutions and individual users. The study employed the purposive sampling methods to select four each of watershed management and user institutions, and three community chiefs as well. Additionally, the convenience

sampling method was used to select nine crop farmers out of 15 in Ituma, 12 charcoal producers out of 16 in Inchaban and nine fishermen out of 15 in Dwomo. Focus group discussions were conducted for these individual users in their homogenous groups from the above-mentioned villages (Ituma, Inchaban and Dwomo). Therefore, in all, a total sample population of 41 was used in the study (Table 1). The data collected was conceptually organised into themes based on the objectives of the study, and analysed manually.

Table 2: Total sample size for the study

Sample units	Sample size
Watershed management organisations	4
Watershed user organisations	4
Community chiefs	3
<i>Individual users</i>	
- Crop farmers	9
- Charcoal producers	12
- Fishermen	9
Total	41

Source: Author's construct

IV. RESULTS AND DISCUSSION

This section presents the results and discussion of the study under the following sub-headings:

- assessment of the extent of community involvement in the management of the Inchaban Watershed.
- examination of the challenges of the management institutions to involve the communities in managing the Inchaban Watershed.

Assessment of the extent of community involvement in management

Focus group discussions with the key societal groups (stakeholders') in the local communities surrounding the watershed, to assess the extent of community involvement, revealed that there have been several meetings with the individual users. The outcomes of the meetings showed that the farmers, for example, had understood very well the concerns of the government about the conservation of the watershed. Indeed the chiefs of the settlements admitted that they had been involved in the discussions on planning and implementation of projects. Interviews with the chiefs of settlements in the watershed buttressed the start of the bottom-up approach in managing the Inchaban Watershed. The first among the local authorities to commend the watershed management institutions was a chief who recalled that the views of local people were taken on board in a number of projects to conserve the watershed. Nevertheless, the submissions of a farmer and the head of a non-governmental organisation in one of the villages indicated that;

"there was poor cooperation among the watershed management institutions which opened a leeway for some farmers, charcoal burners and fishermen to abuse the Inchaban Watershed".

Table 2 gives a picture of the levels of involvement of the key stakeholders in the management process to conserve the Inchaban Watershed.

Table 2: Levels of participation by key community stakeholders

<i>Participation in decision-making for policy formulation.</i>	<i>cooperation with other watershed mgt. stakeholders</i>	<i>monitoring and evaluation of projects</i>
---	---	--

<p><i>Officials from almost all the management institutions come to me to solicit my views on a number of projects to conserve the watershed. I quickly invite the leaders of the Crop Growers Association, and . . . Agreeably, we meet the farmers and have discussions on a few projects (a local chief).</i></p> <p><i>Implication:</i> Individual users of a particular village had shown concern and had been involved at the initial stages of management.</p>	<p><i>We know about some fishermen upstream who dredge and pump much quantities of water from River Anakwari. These practices, I believe, are the causes of the low water supply. Yet we have been blamed for all the malpractices in the watershed (a thirty-four year old farmer)</i></p> <p><i>Implication:</i> Trans-boundary conflicts between upstream and downstream users of the watershed affected the management system. Users in different localities hardly cooperated in management</p>	<p><i>Truly speaking, the unwholesome activities by . . . destructive. The EPA has planted trees and they have been harvested . . . Similarly, the hedges created by the FC have been destroyed by farmers. We had the information that the FC permitted some of the farmers and charcoal burners to use the trees in the watershed (the head of non-governmental organisation).</i></p> <p><i>Implication;</i> Independent management styles gave local users the opportunity to abuse the watershed.</p>
---	---	--

Source: Field Work, 2015

Challenges of community involvement

Matheny (1995) stressed on the need for adequate capacity to involve local communities in natural resource management. According to Matheny (1995) the delivery of services among institutions is better enhanced when the legal system for management is very sound and supportive. Based on the recommendation of Matheny (1995), it was necessary to look at the capacity of the management institutions in terms of availability of funds, logistics, and most importantly, legal mandate for organising programmes that will involve the local communities.

Financial capacity of the management institutions

In an attempt to stop or reverse the degradation of the Inchaban Watershed and secure agricultural farmlands, protect aquatic life and biodiversity, the management institutions in the district have, over the past years faced serious financial challenges. For this reason, a number of them were not able to perform satisfactorily. The financial challenges emanated from a number of factors:

Firstly, the heads of the management institutions recalled instances where their attempts to claim funds from the government yielded no good results. In separate interviews, the heads poured their displeasure on government’s quarterly

subventions which they described as inadequate. Some of the heads of the management institutions said, for nearly three quarters, they had not received any money from the government. The head of the Forestry Commission was quick to add that the institution never received monies from the Watershed Management Fund that was established in 1996. The following remarks tend to support the situation:

We have always been blamed for non-performance. However, we do not get the needed financial support from government. The quarterly funds that we need for routine repair of our vehicles, payment of casual workers, etc. do not come. For nearly two years, all the state institutions have not received any government allocations or funds.

Secondly, the institutions recalled their past bitter experiences when they did not get the support of local authorities (chiefs, district assemblies, leaders of various groups which use the watershed) to mobilise funds locally. Incidentally, under the 1993 Local Government Act 462 of Ghana, the District Assembly is now the highest political and administrative body which is supposed to see to the management of all natural resources (Aryee, 2008). Unfortunately, the management institutions complained that the District Assembly hardly supported them to generate funds even at social gatherings. The general impression gathered in the field was that the administrative role over watersheds vested in the hands of the District Assemblies under Section 11 of the Water Use Regulation Act of 1962 has not been performed.

Thirdly, the management institutions had relied heavily on external support for funding was no longer reliable. According to a World Bank estimates financial assistance to countries for watershed management indicated huge sums of money given to especially developing countries where cost of environmental damage has been generally high. For example, Africa was supported with a total sum of US\$ 311.4 million out of which Ghana received US\$ 94.1 million between 1995 and 1998. According to the heads of the watershed management institutions in the district, several attempts which they had made to solicit funds from international associations such as the World Natural Resource Conservation (WNRC), the World Conservation Strategy and many others, had proved futile. The simple reasons were that the external donors did not accept the project reports sent by the local heads and promised to send down their own project correspondents which they have unfortunately failed to do. This is what the head of one of the management institutions had to say:

We struggle hard to get financial support from external bodies. We wait for so many months, sometimes nearly a year, before getting approval from the WRC to use the little monies that we have solicited. Most at times, we are not able to complete our projects because the District Assemblies have failed to support us in terms of revenue generation.

Nevertheless, the non-governmental organisations in the district had external support in terms of financial assistance. For example, interview with the head of Coastal Resources Centre (CRC) a non-governmental organisation mandated for environmental management gave some examples of the external organisations and some mining companies that had over the years supported many of their projects. He recalled some instances as follows:

We are being supported by external donors such as the USAID, World Fish Environment Sustenance and some oil drilling companies like the TULOW Oil Company in the Western Region of Ghana. We have had several disappointments from the government in terms of financial assistance. Fortunately, we are a bit resourced and it comes through our own initiative and effort.

Technical capacity of the management institutions

The outcome of the in-depth interviews conducted to assess performances of the watershed management institutions indicated that generally the institutions had not performed satisfactorily because of serious challenges relating to logistics and human resources. With respect to human resources all the state institutions complained of inadequate staff. More so, in some instances, the heads said, the government had recruited unqualified personnel. Only one of the institutions, a local NGO (CRC) was averagely resourced in terms of working staff. The rest, especially the state management institutions, conceded that their organisations were seriously handicapped, especially with regards to facilities to organise workshops and train workers. The head of a local NGO in the district narrated some positive steps taken toward improving the human resource capacity of the other management institutions. He had the following to say:

At the moment, we are working on projects on adaptation strategies to floods to support the communities. In so doing, we have invited a few workers from the Forestry Commission and the Environmental Protection Agencies to undergo training in disaster management. Since the past two years, we have had several letters from the government institutions to support them in terms of training of their personnel.

Notwithstanding, a few individual users admitted that they had been educated on several occasions on measures to conserve the watershed. In separate focus group discussions, for example, the charcoal producers and farmers commended the Forestry Commission and the MoFA for revealing them to the best farming practices and erosion control strategies. Using this approach, community support which has now been identified as important technical and human resource was tapped. The management institutions could be commended even though this technical resource had less impact in the management system. However, the local users of the watershed especially, the farmers, could not hide the negative practices of their colleagues on the watershed. The following is what a forty-three year old farmer at Ituma had to say:

At the beginning of this year, the Forestry Commission, the Environmental Protection Agency and the NGOs came to educate us on some farming methods, some of which included, sedentary farming, contour farming and smallholder rehabilitation methods. Yet, a lot of us did not go by these methods. As a result, the soil is being eroded, and this disturbs those of us at the downstream portions of the watershed.

With regards to logistics, government institutions with the greatest responsibilities expressed deepest concerns about the poor state of housing facilities, offices and store rooms, vehicles, computers and other accessories such as printers and photocopier machines. Also, other government institutions complained about inadequate technical equipment such as cutlasses, boots, and attire to patrol the watershed. For example, the deplorable state of vehicles at the Ministry of Food and Agriculture (Plate 1) explains why the institution could not undertake frequent patrols to stop the illegal activities in the watershed.



Plate 1: The poor state of vehicles at MoFA

Legal capacity of the management institutions

The *Water Use Regulation Act of 1962*, supports the integrated water resource management policy of Ghana, and gives WRC the mandate to regulate the use of all water bodies in the country. To make the work of Water Resource Commission easier, the Environmental Protection Agency, Forestry Commission, NGOs and local authorities have also been

assigned specific and separate roles to play to support the WRC to manage water bodies. Serious conflicts were however detected among the local management and user institutions. The local chiefs in the first place, said that the state management institutions did not give them room to exercise their powers. The chiefs recalled instances where they had given permission to some of the farmers and fisher folks to use the watershed, and

have been chased away by the management institutions. For example, the queen mother of one of the communities made it clear that it was time they claimed portions of the watershed to support local economic activities. This statement tends to suggest:

In colonial times, portions of the Inchaban Watershed were demarcated for our forefathers to use. It is just about time we reclaimed the lands that belong to us to support the local people here. We will not sit down and watch other people to use the watershed illegally. I have written several letters to take permission from the management institutions for the local users of the watershed but have not had any good feedback. Personally, I grant some of the local people usage right when they ask for help. I know they receive threats from the government authorities but we still support them in every way.

The Statutory Land Administrative Act 125 of 1962 of Ghana supports the state watershed management institutions to regulate and control the use of all lands such as mineral sites, forest lands and water bodies that fall under the areas of interest of the state (Opoku, 2006). For state watershed management institutions to work effectively, government of Ghana has established institutions as the Lands Commission, the Survey, Town and Country Planning Departments and the judicial courts to support the state's claim for lands for social development. However, the reports obtained from the management institutions showed that the state judicial system, unfortunately, is weak to support governance over the Inchaban Watershed. In most cases, the reports were that certain institutions' took bribes from individual users and overlooked the illegal activities in the watershed. Others have also supported some political leaders to erect structures for self-owned businesses in the watershed. The statement by one of the key informants from the public regulatory bodies indicates that:

Since the last four years we have sent three major cases to the courts requesting the support of the Takoradi Court to stop the construction of buildings in the watershed. As I speak to you, there are two additional cases of illegal construction in the watershed. The courts kept on adjourning the hearing of these cases. We have persistently referred the cases to the local chiefs for support but, to our dismay, the chiefs go behind us to encourage the illegal users of the watershed. Some of the heads in the other sister watershed management institutions pay bribes to the court officials for the cases to be adjourned.

The inadequate cooperation among the management institutions posed legal challenges for the institutions to battle with. Once the management institutions neglected collaborative project building and thus followed, to a large extent, the sectoral management approach, there were always conflicting interests that made the legal mandate challenges very serious.

V. CONCLUSIONS

Based on the results and discussion the following conclusions could be drawn:

- Community involvement in the management process was only up to decision-making level. The communities surrounding the watershed had done virtually nothing to support the watershed management institutions in terms of implementation, monitoring, evaluation and re-

diversification of projects to meet the changing watershed environment. Hence, the community involvement was poor.

- The management institutions performed poorly due to several challenges relating to capacity for operation. Most importantly, with respect to financial and technical capacities of the management institutions, only one of the organisations (CRC) was better resourced by external non-governmental organisations such as USAID and World Fish Environment Sustenance. The rest, that is, the government institutions were seriously handicapped in terms of funds, personnel and logistics. Again there were conflicts in the legal system of administration which grew serious when the courts in the district failed to amicably resolve them.

ACKNOWLEDGEMENTS

The authors thank the staff of the Department of Geography and Regional Planning for giving them office and proof reading the paper. We wish to state categorically that the authors have no issue with conflict of interest.

REFERENCES

- [1] Acheampong, P. K. (2009). The earth themes and variations. Cape Coast, Ghana: University of Cape Coast.
- [2] Arnstein, S. (1969). Participation :A theoretical context. Retrieved from www.arnstein/levels_of_com.part.com on 3/01/2012.
- [3] Arthur, J.& Moore, L. (1999). Approaches in natural resources management. Accra, Ghana:University of Ghana.
- [4] Aryee, J. (2008) Decentralization and Town Development in Ghana. The New Legon Observer, a Ghana Society for Development Dialogue Publication, 2 (9): 6–11.
- [5] Cohen, J.M., & Uphoff, N.T. (1980). Participation's place in rural development: seeking clarity through specificity. World Development Vol. 8.: 213-235.
- [6] Cornor, L. D. & Dovers, M. L. (2004). Challenges in trans-boundary integrated watershed management: National Council for Science and the Environment. Tacoma, WA: Sage.
- [7] Dovers, S. & Dore, J. (2003). Participatory watershed management: A global perspective, Iowa, IA: Iowa State University Press.
- [8] Dukes, E. F. & Firehock, K. (2001). Stages in the participatory water resources management: Environment management in the third world, London, England: Routledge.
- [9] Economic and Social Commission for Asia and the Pacific. (1997). Guidelines and manual on land-use planning and practices in watershed management and disaster reduction. Bangkok, Thailand.
- [10] Food and Agriculture Organisation. (1982) Participation in forest management. Wageningen, Netherlands.
- [11] Food and Agriculture Organisation. (2009). Poverty alleviation and food security in Asia. Bangkok, Thailand.
- [12] Johnson, N. & Ravnborg, H. M. (2001) User participation in watershed management and research. The economics of community watershed. Retrieved from www.capri.cgiar.org on 10/04/201
- [13] King, B., Pizan, A., & Milman, A. (1993). Social impacts of tourism on host perceptions. Annals of Tourism Research, 20 (4), 318-319.
- [14] Kumar, N. & Pretty, H. (2002) User participation in watershed management and research. Water Policy, 3 (6), 507-509.
- [15] Leach, W. D. & Sabatier, P. A. (2002). Approaches in watershed management. Rome, Italy: Packer.

- [16] Martin, G. (2008). Community involvement in watershed management. Buffalo NY: Oxford University Press.
- [17] Matheny, W. (1995). Democracy, dialogue, and environmental disputes: The contested languages of social regulation. New Haven, CT: Yale University Press.
- [18] Opoku, K. (2006) Forest governance in Ghana. An NGO perspective. A report produced for FERN, Forest Watch Ghana.
- [19] Rhoades, R. E. (1998). Participatory watershed research and management: Where the shadows fall. Watershed management research. Retrieved from pubs.iied.org/pdfs/6148IIED on 1/02/2012.
- [20] Sommarstrom, S. (2000). Institutional changes in land administrative policies. Accra, Ghana: Cambridge Press.
- [21] Stewart, F. (1993). Natural Resource Conservation. A set to sustainable development. Albany, NY: Macmillan.
- [22] Walker, B. S. & Carpenter, J. (2002). Resilience management in socio-ecological systems: a working hypothesis for a participatory approach. *Conservation Ecology*, 6(1), 14-18.
- [23] Water Resource Commission. (2000). Institutional framework for water resources management in Ghana. Accra, Ghana: Author.

AUTHORS

First Author – O, D, Mireku, Department of Geography and Regional Planning, University of Cape Coast, Cape Coast, Ghana

Second Author – P. K, Acheampong, Department of Geography and Regional Planning, University of Cape Coast, Cape Coast, Ghana

Third Author – S, Mariwah, Department of Geography and Regional Planning, University of Cape Coast, Cape Coast, Ghana

Fourth Author – K, Adu-Boahen, Department of Geography and Regional Planning, University of Cape Coast, Cape Coast, Ghana

Fifth Author – A. K. Mensah, Department of Geography, Kenyatta University, Nairobi, Kenya

Design of Coax-Fed E-Shaped Microstrip Patch Antenna with Triple Bands

Muhammad Salim Garba

Institute of Antenna and Microwave Techniques, School of Electronics Engineering, Tianjin University of Technology and Education, Dagu South Road 1310, Liulin Dong, Hexi District, Tianjin 300222, P.R- China.

Abstract- Due to its small size, light weight, ease of integration, microstrip patch antenna is been widely applied to the fields of mobile radio, wireless communications, radar systems and so on. This paper presents a method of designing the millimeter-wave microstrip antenna which could be use in government and commercial applications, such as mobile radio and wireless communications that have similar specifications. The designed antenna can achieve triple band performance to simultaneously cover the 1.18GHz, 2.42GHz and 4.05GHz frequency with return loss of -12.50dB, -12.60dB and -15.50dB respectively. The simulation results of the designed triple band E-shaped Microstrip Patch Antenna were also presented. The antenna is of low profile, conformable to planar surfaces, simple and inexpensive to manufacture using modern printed-circuit technology. It was proved that the designed antenna is feasible and realizable. Because such antennas have a very low profile, are mechanically rugged and can be shaped to conform to the curving skin of a vehicle, they are often mounted on the exterior of aircraft and spacecraft, or are incorporated into mobile radio communications devices [1]-[5].

Index Terms- Coaxial Probe Feed, E-shaped Microstrip Patch antenna, HFSS-Software, Triple Frequency Bands.

I. INTRODUCTION

Recently, many communication systems are required to be small in size, which arouses the interest to fusing the step impedance resonator in microwave monolithic integrated circuits. Compared with conventional microwave antennas, microstrip patch antennas are with small size, light weight, simple to manufacture, low cost, and ease of integration such as in mobile radio and wireless communication applications [1]. In high-performance aircraft, spacecraft, satellite, and missile applications, where size, weight, cost, performance, ease of installation, and aerodynamic profile are constraints, low-profile antennas may be required. Presently there are many other government and commercial applications, such as mobile radio and wireless communications with similar specifications. To meet these requirements, microstrip antennas [3] can be used. These antennas are low profile, conformable to planar and nonplanar surfaces, simple and inexpensive to manufacture using modern printed-circuit technology, mechanically robust when mounted on rigid surfaces, compatible with MMIC designs, and when the particular patch shape and mode are selected, they are very versatile in terms of resonant frequency, polarization, pattern, and impedance. In addition, by adding loads between the patch and the ground plane, such as pins and varactor diodes,

adaptive elements with variable resonant frequency, impedance, polarization, and pattern can be designed [3].

This paper describes a method of design of the rectangular Coax-Fed E-shaped microstrip antenna with its distinguish resonant frequencies. The simulation is done using ANSOFT HFSS software; High Frequency Structure Simulator (HFSS) is a high-frequency simulation software which is based on a finite element method and its accuracy and powerful features makes it a common tool for antenna designers, the proposed E-shaped in this paper was no exception. The proposed printed E-shaped antenna is very suitable for integration with wireless local area network (WLAN) applications, widely used in the areas of mobile radio and wireless communication applications, also found very useful in the field of global navigation satellite systems (GNSS), global positioning system (GPS). Other important areas of applications include biomedical, missiles and much more. Currently, the wireless area network (WLAN) in the 2.4-GHz (2.4-2.485 GHz) and 5-GHz (5.15-5.875 GHz) bands is the most renowned networks for accessing the internet and also the antenna for an AP not only requires dual band operation but also needs to have an appropriate radiation profile in both bands, namely equal gain, wide beam width, and high front-to-back ratio. The future generation wireless networks require systems with broad band capabilities in various environments to satisfy numerous applications as smart grid, personal communications, home, car, and office networking. its conformability makes it very much desirable for the use in mobile phone, hand held devices and vehicles such as aircrafts, spacecrafts, marine craft, trains and cars. [1]-[4]

II. ANTENNA DESIGN

The most commonly employed microstrip antenna is the rectangular patch. The rectangular patch antenna is approximately a one-half wavelength long section of rectangular microstrip transmission line. As the antenna is loaded with a dielectric as its substrate, the length of the antenna decreases as the relative dielectric constant of the substrate increases [3]. In this approach, the E-shaped metal film was printed on a dielectric substrate, which is sitting on and perpendicular to a perfectly conducting ground plane. The E-shaped Microstrip antenna is designed to operate at a triple frequency band, the patch was designed as rectangular shaped resonating on FR4 epoxy substrate with relative permittivity dielectric constant of 4.4 and height (H) of 1.6mm. The length (L) of the patch is 27.99mm and width (W) is 37.2 mm. The area of the ground plane sets $74.4 \times 55.98 \text{ mm}^2$. To obtain the desired optimum performance in terms of VSWR and radiation pattern, two rectangular slots with dimension of 19.1mm x 8mm were cut out from both the upper and

lower side of the rectangular patch thus; forming the E-shaped patch shape which in turn yields a significant improvement in terms of the VSWR that became less than two ($VSWR < 2$) for all the three frequency bands. The two slots were separated by a distance of 8mm, this gives the E structure presented by figure 1. However, it is also important to point out that figure 1 and figure 2 were drawn not into the scale of the proposed antenna, thus it has been enlarged for clarification purpose.

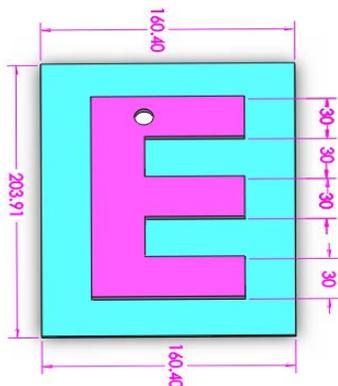


Figure 1: E-shaped printed antenna

A 50Ω coax probe feed is directly attached via the circular cut out (Lumped port) on the upper arm of the E-structure with a radius of 1.5mm circular port. The cylindrical coax pin is made up of the pec (Perfect electric conductor) material with a radius of 0.6mm and the height of 1.6mm. The coaxial-line feed defines; where the inner conductor of the coax is attached to the radiation patch while the outer conductor is connected to the ground plane [3] as can be seen in figure1. For the radio frequency system, application of these antennas must be matched to the traditional 50Ω impedance of the front end circuitry. Therefore, the impedance network has to be plugged between the source and antenna.

III. ANALYSIS AND CONFIGURATION

In this paper, the transmission-line model was employed to configure the designed E-shaped patch antenna because it is easier to illustrate and it gives good physical insight. Although in some applications, such as in government security systems, narrow bandwidths are desirable. However, there are methods, such as increasing the height of the substrate, which can be used to extend the efficiency and bandwidth [3]. In microstrip patch antenna there are some well-known methods to increase the bandwidth of patch antennas, such as, cutting a resonant slot in the patch, reduced ground plane, the use of thick substrate, the use of a low dielectric substrate, the use of various impedance matching feeding techniques, the use of slot antenna geometry and multi-resonator stack configurations. However, the bandwidth and the size of an antenna are generally reciprocal conflicting properties such that improvement of one of the characteristics normally results in degradation of the other one. Various shapes of cutting slots and slits have been designed on patch antennas to reduce their size. These shapes of slots that are embedded on the

antenna are used to increase the surface current path, so in this design was the reason for the E-shaped patch. The figure 2 below gives the Isometric view of the designed E-shaped patch antenna with triple frequency bands.

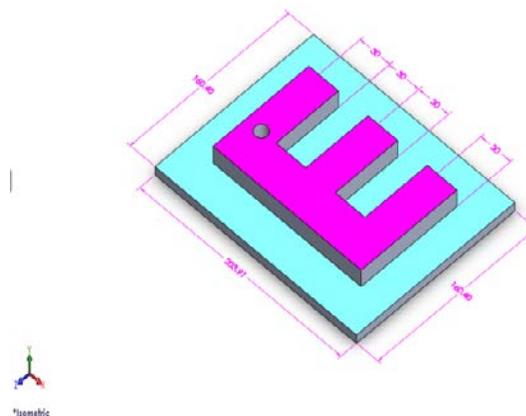


Figure 2; Isometric View of the E-shaped Patch Antenna

To decrease the resonant frequency of an antenna for a given surface area, the current path must be maximized within the area. For efficient radiation, the size of Microstrip antenna should be $\lambda/2$. If the size reduces less than $\lambda/2$, the radiation efficiency of antenna decreases along with other antenna parameters. The miniaturization of antenna and improvement in bandwidth can be achieved by etching the slot in ground and patch of Microstrip antenna of proper length and width value [4].

The simulated results were obtained by using the Ansoft HFSS; high frequency structure simulator (HFSS) software. The measured simulated characteristics of the antenna were presented as regards to the return loss (in figure 4), voltage standing-wave ratio (in figure 5). Finally the design is covered with a vacuum air box and then validation and thus simulation and analysis as shown in figure 3 below.

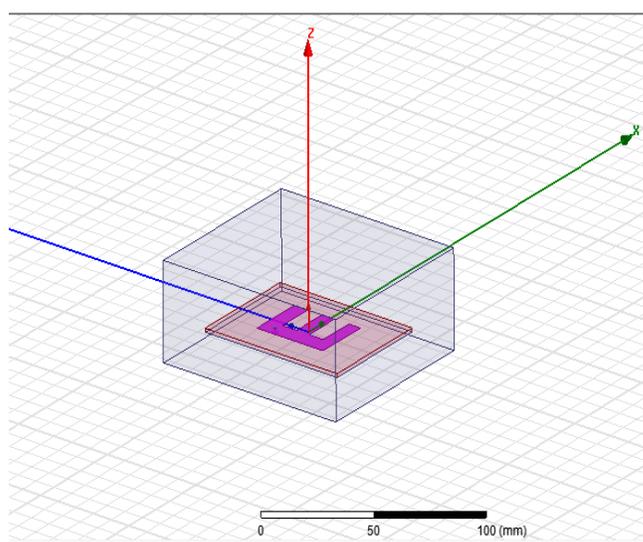


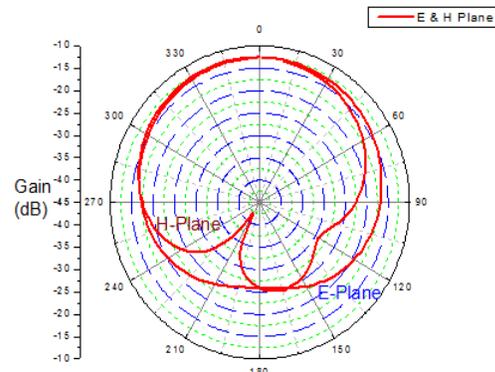
Figure 3: Simulation of the patch antenna.

IV. RESULTS AND DISCUSSION

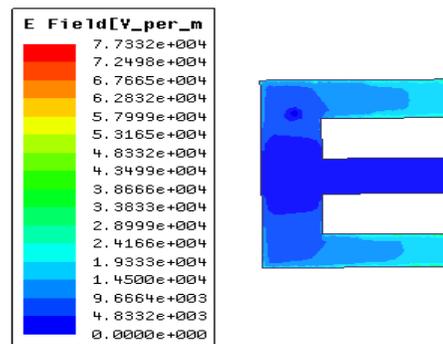
In this section the rectangular patch antenna was designed and experimental results regarding the radiation characteristics are presented and summarized as can seen in the table 1 below. The simulated results were obtained by using the Ansoft simulation software; high frequency structure simulator HFSS. The measured simulated characteristics of the antenna are shown from the return loss, voltage standing-wave ratio (VSWR), radiation pattern as well as the current distribution in the patch. Good return loss and radiation pattern characteristics were all obtained in the frequency band of interest.

Table 1

S/N	Frequency (GHz)	Return loss (dB)	VSWR	Bandwidth (MHz)
1	1.18	-12.50	1.50	300
2	2.42	-12.60	1.45	280
3	4.05	-15.50	1.50	300



(a) Radiation Pattern at 1.18GHz



(a) Current Distribution at 1.18GHz

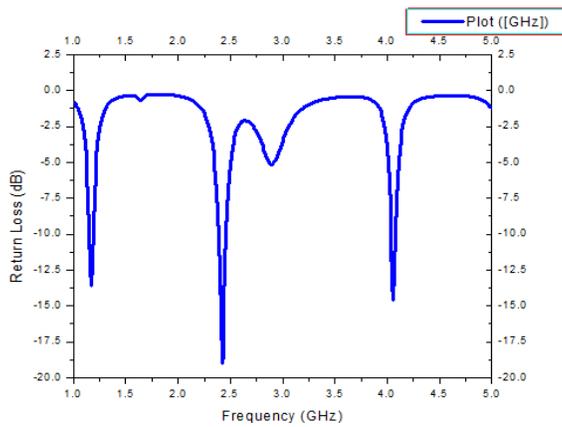
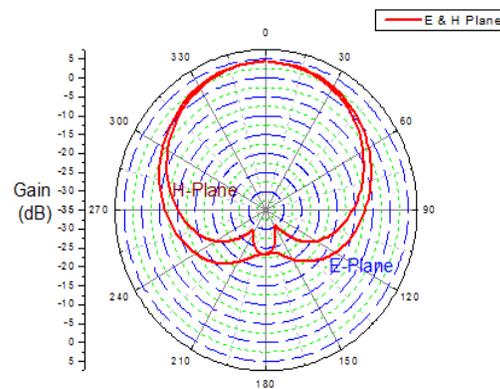
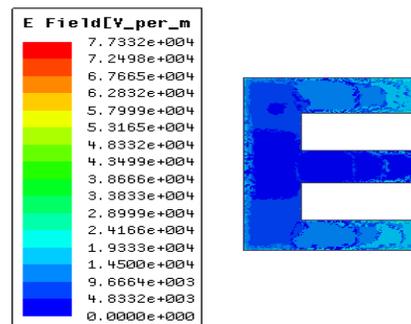


Figure 4: Return Loss



(b) Radiation Pattern at 2.42GHz



(b) Current Distribution at 2.42GHz

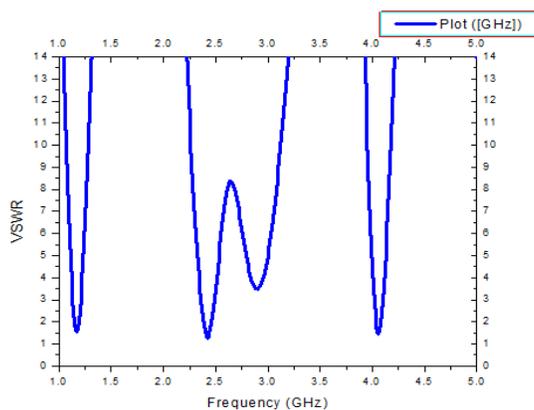
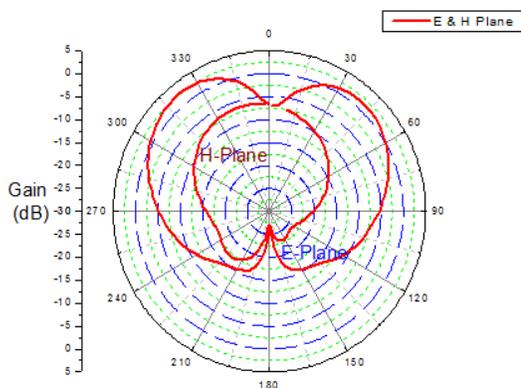
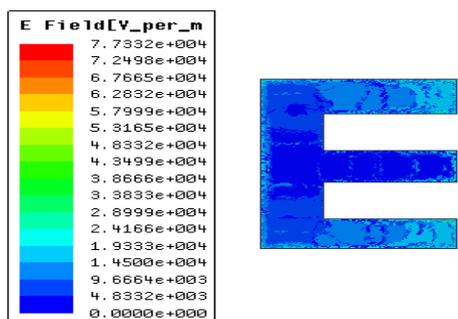


Figure 5: Voltage Standing Wave Ratio (VSWR)



(c) Radiation Pattern at 4.05GHz



(c) Current Distribution at 4.05GHz

The radiation patterns for the three frequencies for 1.18GHz, 2.42GHz and 4.05GHz bands with their corresponding current distribution were presented in the figures (a), figure (b) and figure (c) respectively in terms of the E and H planes as shown above. To examine the radiation characteristic of the triple band antenna structure, the current distribution of the triple bands for the 1.18GHz, 2.42GHz and 4.05GHz E-shaped antenna were also presented.

V. CONCLUSION

The designed antenna can achieve triple band performance to simultaneously cover the 1.18GHz, 2.42GHz and 4.05GHz frequency with return loss of -12.50dB, -12.60dB and -15.50dB respectively. The simulation results of the designed triple band E-shaped Microstrip Patch Antenna were also presented. The designed antenna application systems include the wireless area network (WLAN) in the 2.4-GHz (2.4-2.485 GHz), global system for mobile communication (GSM), global positioning system

(GPS), Worldwide Interoperability for Microwave Access (WiMax), global navigation satellite systems (GNSS) as well as Wireless communications enjoying exponential growth in Industrial, Scientific, and Medical (ISM) band. Other important areas of applications include biomedical, missiles and much more. Therefore, the designed triple band for 1.18GHz, 2.42GHz and 4.05GHz E-shaped patch antenna in this paper are in great demand, and becomes more important. It is suitable for wireless communication systems operating at very lower frequency of 1.18GHz, 2.42GHz and 4.05GHz bands.

ACKNOWLEDGMENT

This work was supported by the China Scholarship Council (CSC), student number 07M2013030L, through the Institute of Antenna and Microwave Techniques, School of Electronics Engineering, Tianjin University of Technology and Education, 1310 Dagu South Road, Liulin Dong, Hexi District, Tianjin 300222, P.R- China.

REFERENCES

- [1] C. -X. Sun, L. -Y. Feng, X. -Y. Liu, and H. -X. Zheng, "A comb-shaped antenna for the lower profile in L-Band," *International Conference on Microwave and Millimeter Wave Technology*, ICMMT Shenzhen, China, May 5-8, 2012.
- [2] Bulletin of Advanced Technology Research, "The Design of 30GHz Microstrip Antenna" Vol. 5 No.3/ Mar. 2011
- [3] Constantine A. Balanis ; *Antenna Theory Analysis and Design*, 3rd edition. Wiley, 2005, ISBN 0-471-66782-X;
- [4] Jitender Chauhan¹, Parveen Kumar², Amit Kumar³ "Design of CPW-fed 'E-G' shaped Microstrip Antenna for WLAN and WiMAX Applications " *International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)* , Volume 2, Issue 12, December 2013.
- [5] Dr. Otman El Mrabet, "HFSS Tutorial", Ansoft Corporation, *HFSS User's guide*, ver. 13, 2005.

AUTHORS

First Author – Muhammad Salim Garba, Master of Engineering, Institute of Antenna and Microwave Techniques, School of Electronics Engineering, Tianjin University of Technology and Education, msalimgarba@hotmail.com.

Correspondence Author – Professor Hongxing Zheng, hxzheng@126.com, +8613194621955.

Mobilization Strategies for Effective Community Development Projects in Igbo-Etiti Local Government Area of Enugu State, Nigeria.

Ewelum, Johnson Nnadi (Ph.D)^{*}, Mbara Kingsley Ugochukwu (Ph.D)^{**}

^{*}Department of Adult Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.

^{**}Department of Adult and Non-formal Education, Alvan Ikoku Federal College of Education, Owerri, Imo State, Nigeria.

Abstract- The central purpose of the study was to identify the mobilization strategies for effective community development in Igbo-Etiti Local Government Area, Enugu State, Nigeria. Three research questions guided the study. The study adopted a descriptive survey design. The population of the study consisted all the community-based organizations leaders in the thirteen communities that make up the area. The sample of the study was 370 community leaders selected through purposive sampling technique. Questionnaire which has three clusters and was validated by two experts in community development was the instrument for data collection. The reliability of the instrument was determined using Cronback Alpha and the coefficient obtained from the three clusters respectively were 0.83, 0.81 and 0.85. Mean was used to analyze the data. Some of the findings include that the major ways people participate in community development projects include financial assistance and manual labour. Among the problems that militate against peoples' participation in community development projects are lack of funds, poor leadership, inadequate mobilization strategies, embezzlement of money. Some of the mobilization strategies include involvement of people in development programmes, formation of organizations use of persuasion, adequate communication, among others. Some of the recommendations include that people should be involved in all the stages of development, community organizations should be encouraged, etc.

Index Terms- Community Development, Mobilization, Strategies.

I. INTRODUCTION

Mobilization is one of the basic strategies of community development (C.D). According to Imhabekhai (2009), mobilization is the process of putting people into readiness for active service or of arousing the interest and consciousness of a group of people in a programme, which would be of benefit to them. There is an assumption that the intended participants have not become aware of the existence, the objectives or the advantages to be derived from the programme. Mobilization, therefore, is providing sufficient information about a programme contents and objects in order to elicit the support and participation of the people in the programme. Abiona (2009) noted that mobilization involves creating awareness of certain problems existing in the community and which need urgent

attention. Awareness might take a form of educating the people on what they do not perceive as a problem. It means they have to be informed of the problem and told at the same time that the solution lies in their hands as they have the capacity to do this. Moreover, they need to know and understand that there are benefits to be derived if the problem is solved.

Esenjor (1992) noted that most development centred around people and this is why one of the most persistent concerns in development literature is about ways people may be mobilized for given programmes or for the resolution of given problems that impinge on development itself. Therefore, it is clear that any community which fails to develop the skills and productive talents of her people and to effectively mobilize and utilize such skills to transform that community economy will be unable to achieve real development. This is why mobilization is relevant to the community development projects. Anyanwu (1999) defined community development as the process in the life of a community, by which the people plan and act together for the satisfaction of their felt needs. Its primary purpose is to bring about change for better living, through the willing cooperation of the people.

A successful mobilization hinges on citizen participation in order to create new ideas and resources in the community. This entails involvement of the local people in decision-making, planning and execution of the project. Mobilization helps in galvanizing the local people to participate in developing their community, using local initiatives. The active participation of the people will foster success in any project which they embark upon. It encourages self-help and utilization of human and material resources to utmost capacity for community development.

Since independence 1960, successive Nigerian governments had made specific provisions for community development in the national development plans because development through communal initiative and efforts is officially recognized as a rewarding and desirable complement to the elaborate plans for integrated development. To give a strong expression to community development, Nigeria has witnessed a number of government initiated national development programmes with embedded and inherent community development goals and objectives. Some of them include; The Green Revolution, Operation Feed the Nation (OFN), the Mass Mobilization for Social Justice and Economic Recovery (MAMSER), Directorate for Food, Roads and Rural Infrastructure (DFRRI), Better Life for Rural Women, Family Support Programme (FSP), among others. All these national and State Programmes involved

mobilization of people for development at groups and community levels. The indications are that given the directive nature of these governments initiated programmes, the institutional development dynamics for community development at the grass root levels should be well established by now.

Despite the efforts of the governments in introducing different national development programmes in the country, there is no evidence to show that a reasonable percentage of the people in rural communities in Igbo-Etiti local government area participate in community development projects. Experiences of the staff, especially those under community development unit in the local government have shown considerable and progressive deterioration of community development projects in many communities which has created a gap for non-involvement of people in development activities. This concern stem from the fact that while there are indications that some of the national development programmes have positively influenced community development in some areas, there are also indications that in some areas like Igbo-Etiti Local Government Area, active participation does not seem to be noticeable. Could it be that the mobilization strategies adopted by these government programmes were inadequate or that a lot of factors militate against the community development projects embarked upon? However, it is possible that if adequate mobilization strategies are employed in the area, the deterioration in people's participation in community development projects can be reversed, hence the need for this study.

II. RESEARCH QUESTIONS

Three research questions were posed to guide the study:

1. In what ways do people participate in community development projects in Igbo-Etiti LGA?
2. What are the problems that militate against people's participation in community development projects in Igbo-Etiti LGA?
3. What are the mobilization strategies for people to participate in community development projects in Igbo-Etiti L.G.A?

III. METHODS AND MATERIALS

Descriptive survey design was adopted for the study. The population of the study consisted all the community-based organizations leaders in the thirteen communities that make up Igbo-Etiti Local Government Area of Enugu State, Nigeria. The sample of the study was 370 leaders selected through purposive sampling technique. Questionnaire, which was developed in three clusters and validated by two experts in community development was the instrument for data collection. The reliability of the instrument was determined using Cronbach Alpha. Coefficient of 0.83, 0.81 and 0.85 were obtained from the three clusters respectively and they were adjudged highly enough. A criterion mean of 2.5 was adopted. This implies that items within the mean of 2.5 and above were accepted while those below 2.5 were rejected. The mean scores were also ranked from the highest to the lowest.

IV. RESULTS

Table1: Mean Scores of the leaders on the ways people participate in C.D projects in Igbo-Etiti LGA.

S/N	Ways of Participation	Mean	Rank
1.	Finacial assistance	2.78	1 st
2.	Material assistance	2.16	3 rd
3.	Manual Labour	2.56	2 nd
4.	None of the above	2.06	4 th

Table 1 revealed that items 1 & 3 were accepted by the respondents because the means were above the criterion mean of 2.5 while items 2 & 4 were rejected because their means were below the criterion mean of 2.5. This implies that the people only participate in C.D projects through manual labour and financial assistance to execute the projects and no other ways again.

Table 2: Mean scores of the leaders on the problems militating against people's participation in C.D. projects in Igbo-Etiti LGA

S/N	Problems	Mean	Rank
1.	Lack of funds	3.53	6 th
2.	Inadequate mobilization	3.62	3 rd
3.	Poor leadership	3.66	2 nd
4.	Lack of trained workers	2.84	12 th
5.	Lack of people's involvement	3.46	7 th
6.	Inadequate publicity	3.55	5 th
7.	Conflicts	3.10	10 th
8.	Lack of managerial known-how	2.98	11 th
9.	Illiteracy/ignorance	3.12	9 th
10.	Poor accountability/embezzlement	3.71	1 st
11.	Selfishness of some leaders	3.40	8 th
12.	Poor planning and implementation of projects	3.56	4 th

Table 2 revealed that all the items 1-12 were accepted by the respondents. This was because all the means were above the criterion mean of 2.5 which implies that they are problems militating against people's participation in C.D. Projects in Igbo Etiti L.G.A.

Table 3: Mean scores of the leaders on the mobilization strategies for people to participate in C.D. projects in Igbo-Etiti LGA.

S/N	Mobilization Strategies	Mean	Rank
1.	Involvement of people in project processes	3.83	1 st
2.	Formation of community-based organizations	3.56	3 rd
3.	Formation of committees	3.30	7 th
4.	Self-help efforts	3.58	2 nd
5.	Promise of compensation	3.42	6 th
6.	Use of persuasion	3.50	4 th
7.	Face-to-face discussion	3.18	9 th
8.	Use of mass media of	3.21	8 th

	communication		
9.	Integrated rural development	3.48	5 th
10.	Letters to the people on what they should do to benefit themselves	3.11	10 th

Table 3 equally showed that all the items 1-10 were accepted by the respondents. This was because all the means were above 2.5 which is the criterion mean. This implies that all the items are mobilization strategies for people to participate in C.D. projects in Igbo-Etiti LGA.

V. DISCUSSION

The result in table 1 showed that people participate in community development project in many ways and that manual labour and financial assistance are most prominent. This is in agreement with Oduaran (1994) who said that the success and failure of community development depends to a considerable extent on the ability of the community to generate necessary funds for the funding of projects, services, administration and personnel. Fund raising provides an open door for mobilizing. The idea of participation also corroborate with Imhabekhai (2009) that citizen participation means active involvement of all the men and women in a community, irrespective of age, nature of citizenship, socio-economic status, political affiliation, religion, level of education, etc. in planning and implementing programmes and projects that are of benefit to the people. This implies that every body in the community should participate in one way or the other in community development programmes to engender desired development in the community.

The data on table 2 revealed many problems that militate against people's participation in C.D. projects ranging from lack of funds to poor planning and implementation of projects. These problems agreed with Abiona (2009) especially on lack of funds that many communities make efforts to embark on self-help programmes but cannot implement such successfully because of limited funds. Such communities sometimes depend on grants from the government to supplement what they have contributed but such assistance from government might not be forth coming or might come too late. This often leads to abandonment of good projects midway. Moreover, many members of the communities might not fully cooperate to meet their financial obligations to the projects due to poverty or lack of interest in the said projects. The author went further to say that the limited funds contributed by members of the communities may be embezzled by community leaders and others. This brings mistrust and kills the interests of the community members who are willing to participate in community development. In the same vein, Esenior (1992) summarized the problems thus: notion and ideas about the programme, foundation of the programme, problem in regard to the unit of the community development, size of the unit and the problems connected with it, lack of trained or professional workers, flexibility of community development ministries/agencies, misuse of powers, lack of adequate funds, lack of peoples' involvement, bureaucratic delays, overburdening of incompetent subordinate workers, poor leadership and poor accountability.

The data on table 3 also revealed a number of mobilization strategies that work when they are employed. Such strategies have worked in some areas depending on the situation in a given environment. This in conformity with Anyanwu (1987) that, at the grassroot level, the idea of mobilization can only be achieved by stimulating active participation of the entire citizenry through different methods which include: face-to-face discussion, letters to the communities telling them what they suppose to do, addressing a group of people, formation of committee in which the masses in all shades of opinions are represented, formation of organizations or unions and launching of the projects in different phases.

Onabanjor (1986) supports that "the most effective system which has been adopted and used by Kwara State Ministry of Local government for effective mobilization is the committee system". He maintained that, apart from its being a permanent forum for exchange of ideas, it is very instrumental in mobilizing the masses for self-help activities since members are the accredited representatives of the people to be mobilized. In the same vein, Abiona (2009) affirmed that communication network both internal and external is vital in mobilization. At every stage of mobilization, communication is the main tool of success, otherwise the programme will not take off. It is through communication that community members can be involved in the mobilization process. For mobilization to be effective, members of the community must have access to information which they need to identify and solve problems.

VI. CONCLUSION

From the foregoing, it is evident that mobilization consists primarily the movement or campaigns to activate the masses into the process of change. This involves pooling of the human and material resources of the people for their betterment in their community. Through mobilization, people can participate in different ways in development of their community which come in form of financial, material and manual labour. Unfortunately, some people may be constrained because of some factors that may militate against their participation in community developments programmes. A number of mobilization strategies were therefore suggested to ameliorate the problems if employed to encourage popular participation in community development projects.

VII. RECOMMENDATIONS

Based on the findings, the following recommendations were proffered.

1. People should be involved in identification, planning, execution and evaluation of projects in their communities. This will go a long way in making the people see the projects as their own and that they belong to the whole processes of development.
2. Government should provide the people with well trained community development personnel for proper direction of what the people are to be done.
3. There is the need to mount campaign or reawaken the peoples' consciousness on the importance of community

development. This will make them rethink from their former belief on community development.

4. Community organizations should be encouraged and committees set at the inception of any projects. This is to accelerate the rate of self-help efforts in the communities.

REFERENCES

- [1] I.A. Abiona, Principles and practice of community development. Ibadan: Ibadan University Press, 2009.
- [2] C.N. Anyanwu, Developing adult education in Nigeria. Ibadan: University press Ltd, 1987.
- [3] C.N. Anyanwu, Introduction to community development. Ibadan: Gabesther Educational Publishers, 1999.
- [4] A.F. Esenjor, Nuts and bolts of community development for students and practitioners. Delta: Esenkin Nigeria Services, 1992.
- [5] C.I. Imhabekhai, Management of community development programmes and projects. Benin-city: Uniben Press, 2009.

- [6] A.B. Oduaran, An introduction to community development. Benin-city: Uniben Press, 1994.
- [7] C.A. Onabanjor, Guideline for the construction, maintenance and utilization of Nation-wide rural roads. New Nigeria, 1986, June 2, p.4

AUTHORS

First Author – Ewelum Johnson Nnadi (Ph.D),
Department of Adult Education, Nnamdi Azikiwe University,
Awka, Anambra State, Nigeria.

Second Author – Mbara Kingsley Ugochukwu, Department of
Adult and Non Formal Education, Alvan Ikeku Federal College
of Education, Owerri, Imo State, Nigeria.

Correspondence Author – Ewelum Johnson Nnadi (Ph.D),
Department of Adult Education, Nnamdi Azikiwe University,
Awka, Anambra State, Nigeria

Cause of Land Degradation and Its Impacts on Livelihoods of the Population in Toke Kutaye Woreda, Ethiopia

Feyera Deresa* Tsetadiregachew Legesse**

* Mizan Tepi University, School of Agriculture and Natural Resource, Department Of Natural Resource Management

** Adama Science and Technology University, School Of Humanities and Law, Department Of Geography and Environmental Management

Abstract- Land degradation in most developing countries is becoming a major constraint to future growth and development of rural livelihoods. About 40-75% of the world's agricultural land's productivity is reduced due to land degradation (Baylis et al., 2012; UNCCD, 2013). This has strong impact on the livelihood of the most population living in the rural areas; Majority of the primary data of this study was collected through household survey questionnaires, field observations and key informant interview. Descriptive statistics such as mean, frequency, percentage, and tabulations were employed to compute the land degradation and anthropogenic factors of land degradation. Multiple linear regressions was deployed for this work in order to know the relationship between the anthropogenic factors of land degradation on Crop Productivity of rural households .A key finding of this study is that the farmers pursue a diverse range of livelihood strategies in addition to agricultural activities. Experience of HHs, farm land hector size, amounts of fertilizer used and sex of HHs are each uniquely explained 8.9%, 1.6%, 1.9% and 0% of the variance in total crop production. Variables such as, education level and family size of HHs are insignificant because the p-values are greater than 0.05, whereas the four variables are significantly determining the crop production. Use land degradation risk to prioritize investments and build donor commitment plus grassroots participation to long-term engagement in the Study area:

Index Terms- Anthropogenic factors, Crop Production, Deforestation, Erosion, Land Degradation, Livelihoods

I. INTRODUCTION

Ethiopia is among the poorest country where land degradation caused damage to its inhabitant. This physical deterioration of its area had left millions of its population in suspicious how to live harmoniously with nature and smooth handling of their livelihood. The fault of land deterioration that were observed in early settlement areas of the north is seems to repeat it self in the remaining part of the country as recent phenomena. Areas abandoned or managed at low levels productivity and affecting 20-50% of the land and some 6 - 11 million people each year. Still land degradation lingers and presents the greatest threat to the survival of the nation (D.L. Johnson and L.A. Lewis, 2007.) Both extent and severity of the problem of land degradation spatial variations depending on different relief, ecology, rainfall, land use, land cover and soil types being as proximate and

underlying causes. (Ayalnen ,D 2003). About 40-75% of the world's agricultural land's productivity is reduced due to land degradation (Baylis et al., 2012; UNCCD, 2013). Land degradation has negative consequences on agriculture. (Olsson et al.2005).

This study therefore seeks to identify the main impact of land degradation on livelihoods of the study area in direct and indirect ways and off-farm activities in addition to farming lands to change and improve their livelihoods.

The following are the research question of the study:

- What are the major causes of land degradation?
- What is the impact of land degradation on crop production of rural households?
- What effective adaptive mechanisms have the inhabitants developed to sustain their livilyhood?

II. RESEARCH DESIGN, METHODS AND PROCEDURES

Location

The study area, *Toke Kutaye*, is one of the 18 districts of the West Shewa Zone of Oromia Regional State in Ethiopia with the total area of 788.87 square kilometres (78887 hectares) (WOAD, 2013) and with total population of 119,999 of which 104047 (86.7 %) is rural and 15,952 (13.3 %) is urban dwellers. (CSA and IRP-CNR. (2001).CSA (2010),

Astronomically it is located between 10°45' N - 10°90' N and 37°50' E to 40°50'. The area is bounded by Caliya and *Nonno* district in the West, *Midaqegn* district in the North, Ambo and *Wanchi* districts in the East, and Tuqur inchni district in the South. (WOAD, 2013). (See Figure 1) It has three agro-climatic zones: lowlands (desert/*berha*) 18%, midland (/sub-tropical /*Woina Dega*) 55% and highland (temperate/ *Dega*) 27 %. The district has bimodal rainy season: the summer, autumn, and spring based on the information obtained from CSA (2010).

Mixed agricultural practices (crop production and livestock rearing) are the major means of livelihood of the study area. Crop production is the dominant agricultural activities that most of the population of the study area engaged in and are earning their life. The livestock sub-sector plays an important role in the livelihood of the rural people in terms of providing alternative income sources, as a strategy in building resilience to shocks, stress and also in contributing to their food security. (FAO,2013)

The case study was conducted in mid highlands of Ethiopia, *Toke Kutaye* district of the West Shewa Zone in Oromia Regional State. It was undertaken on the impact of land degradation on livelihoods of peasants. The land degraded communities are found to be varied in terms of their agro-ecologies and gender (FHHs, MHHs) Musa, D. (2008)... For achieving these objectives, mixed approaches of both qualitative and quantitative research methodologies were employed

Among the 35 districts, two *kebeles*, "neighbourhoods" *Metti* and *Irrencha*, of the *Toke Kutaye* district were purposively selected considering the background of the population, homogeneity, similarity in, wealth, education level of the respondents. Ten per cent (10%) of the study population i.e. 100 household samples were selected out of the total 1000 households by simple random sampling methods. The proposed questionnaires were distributed; interviews and focus group discussion were employed accordingly.

For the analysis of the collected data, descriptive statistics such as mean, frequency, percentage, and tabulations were employed to compute the land degradation and anthropogenic factors of land degradation. Multiple linear regressions was deployed for this work in order to know the relationship between the anthropogenic factors of land degradation on Crop Productivity of rural households

The traditional production function was used to examine the crop productivity of farmers in the study area. The crop production model is stated thus; $Y = c + B_1 Q_1 + B_2 Q_2 + B_3 Q_3 + B_4 Q_4 + B_5 + B_6 Q_6 + e$. Where: Y = value of crop produced by household head; and Q1= Household family size per household head; Q2= Education level of household head; Q3= Farm size in hector per HHs head; Q4= How long household head worked on farm land; Q5 = Quintals of fertilizer used per hectors; Q6= Sex of household head; e = error term; c = constant.

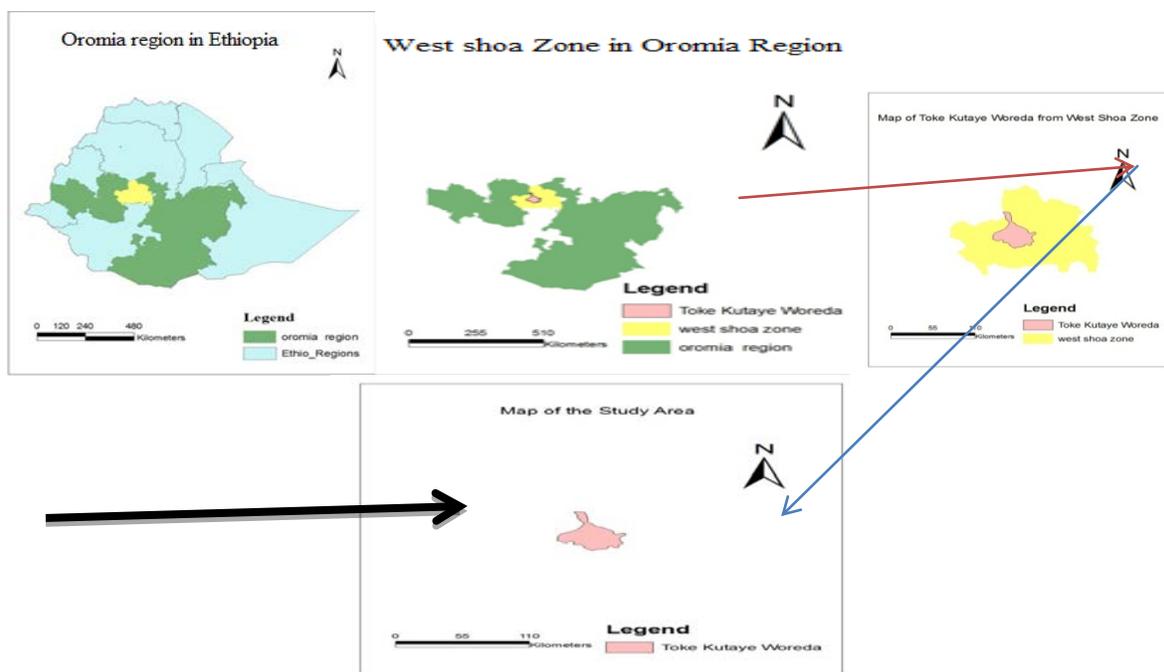


Figure 1 Map of the Study area. Source: Woreda Administrative Office, 2014

III. RESULT AND DISCUSSION

Cause of land degradation

Identification of the cause of land degradation is important for knowing the main factors contributing the loss of the resource in return influence the sustainability of the life and helps to take appropriate measurement to halt it

Table 3.1: Cause of land degradation on HHs farm land

causes	Frequency	Percent
Deforestation	18	27.7
Over grazing	5	7.7
Heavy rain	20	30.8
Wind	3	4.6
poor tillage	9	13.8
over population	10	15.4

Source: Own survey, April, 2014

Table 3.1 indicates, the main cause of land degradation are soil erosion by heavy rain (30.8%), clearances of forests for different purpose (27.7%), over population (15.4%), poor tillage (13.8%), over grazing (7.7%) and winds (4.6%) by which leads the people to inability to sustain their life, increase the food crisis and poverty. As observed from the table the fall of forest area had created favourable condition for heavy rain fall to do its activity to remove soil particles from one locality to another. The studies of WMO (2005) suggest that rainfall is the most important climatic factor in determining areas at risk of land degradation and potential desertification. Rainfall plays a vital role in the development and distribution of plant life, but the variability and extremes of rainfall can lead to soil erosion and

land degradation. These vulnerabilities become more acute when the prospect of climate change is introduced. Land degradation has resulted in the loss of the soil s productivity capacity which is a great concern to the local people (Biielders et al., 2001) who are mainly subsistence farmers

Ranking of agricultural land scarcity farmers’ rural household vulnerability factor

This is identifying the main vulnerability factors that influencing the land scarce farmers and makes their life to be deteriorating. Therefore sorting their degree of impact and taking measure is mandatory.

Table 3.2: Rank of agricultural land scarcity farmers’ rural household vulnerability factors

Problem	Rank	Total responses
shortage of farm land	1	98
Natural resource degradation	2	95
Soil erosion	3	93
Deforestation	4	90
Erratic rain fall	5	80
Unemployment	6	65
Death of farm animals	7	60
Hunger/food crisis	8	60
Low harvest	9	50

Source: Own survey, April, 2014

As indicated in Table 3.2 above, nine vulnerability factors are affecting the crop production in study area. As the result land was affected by multiple factors and percentages presented as follows. Shortage of farm land(98%), land degradation (95%), soil erosion (93%), deforestation (90%), Erratic rain fall (80%), unemployment(65%), death of farm animals(60%), hunger/food crisis(60%), and low harvest(50%). The farmers were unable to pay their debts. for their fertilizers and other inputs due to unemployment and loss of livestock and crop harvests. Erratic rain fall was observed as one of the serious problem for food crises in the area. Reta (2010) also indicated the same results saying this vulnerability and shocks raise price and supply problems of fertilizer and herbicide, high price for renting land, rainfall fluctuations, seasonal food security problem, natural resource degradation, poor human capital, and pests and rodents (rat, monkey), which are almost affecting the area as whole.

Optional work in which respondents are engaged for sustaining livelihoods

The household of the study area engaged into different activities to sustain their livelihoods in addition to agricultural activities. The off farm activity is supporting the life of the people more than only depending on farm activities.

Table 3.3: Optional work in which respondents are engaged for sustaining livelihoods

Optional works	percent
Daily labor	3.1%
Farm animal sale	7.7%
Government employment	3.1%
Hand craft	7.7%
No optional work	56.9%
Retail of crop	1.5%
Selling alcohol	3.1%
Selling roots and fruit	16.9%

Source: Own survey, April, 2014

As indicated at Fig 3.3, the engagement of people to additional/optional work to agriculture, 56.9 % those do not have optional work rather than working on agriculture, 43.1 % are engaged themselves to other optional work like selling roots and fruits, farm animal and hand craft work, alcohol making, government employment and daily labor, and retailing of grain. The additional work is important to fill the gap of food shortage, cost of fertilizer and reduce land degradation but few of the people are working on complementary work to sustain their livelihoods.

While MHH leaving for off farm activities women and children were unable to practice land and crop protecting

activities. This resulted in yield reduction and land degradation. This also supported by Holden, *et al.* (2004) study of Northern Ethiopia that suggested access to non-agricultural activities leads to increasing soil erosion and land degradation and entailing a fall in agricultural factor productivity. This also contrasts with Davis (2008) from the rural Vietnam that revealed seasonal migration causes less use of agricultural inputs. Moreover, the outcomes of this research suggested that the participations of land scarce farmers in the non-agricultural activities have a significant spill over effects on agricultural income through raising the total agricultural factor productivity and decreasing burden on small plot of land. It has complementary to household farming in which non-agricultural income serves to overcome credit market failures. Poor farmers were not interested to engage on farm activity because of lack of drought animals, financial constraint to buy inputs, and stored food to survive. Instead they rent their plot to rich farmers or give in crop sharing agreement. In this case neither the sharecropper nor the landowners seriously take caring soil fertility through different land management practices.

Table 3.4 Deterioration of livelihoods of respondents by land degradation

	Frequency	Per cent
Yes	48	73.8
No	17	26.2
Total	65	100.0

Source: Own Survey, May, 2014

As indicated at table 3.4. The majority respondents' (73.8%) agreed that their livelihood is deteriorating from years to years. While the remained 26.2% of the respondents answered differently. They said no land deterioration in their plot since they were supported by their level of education and financial status that they have. Most farmers were complained that climate variability's were more responsible for moving to unsustainable life situation. Delay of rain fall affected land preparation and crop production in amount. Too much rain fall was responsible to remove fine and fertile soil which is responsible for creation of hunger and deterioration of the life condition of the population in the area.

As the result of land degradation whether due to climate change, erosion or drought there is costs to be paid to manage the problems incurred. For instance the cost of fertilizer to boost yield, conservation and plantation are some of the results of land degradation

Table 3.5 Types of crops as factors of degradation

Types of crop	%
Barely	40%
wheat	33%
Bean	12%
pea	2%
Maize	2%
Teff	2%
Other	3%

Source: Own survey, April, 2014

As illustrated in the table 3.5, barley (40%) is the most important crop in the area followed by wheat (33%), bean (12%), pea (8%), maize and teff (2%) and other production contain (3%). Most crops have high ecological adaptability with high ability to fix nitrogen to the soil but their ability to fix nitrogen is not matching with what the population is doing in the area. Naturally these crops need more space to grow which can allow the removal of soils particles during early growth of plants and after harvest if heavy rain fall occurs in the area. These crops canopy and crop residue only protect the soil for a relatively short period of time. Neither soil fertility nor better livelihoods can be achieved. This has a negative impact on eroding soils and enhancing land degradation in the area.

Table 3.6: Average of livestock of the respondents

Livestock	Total	TLU conversion	TLU	%
oxen	117	0.7	81.9	24%
cows	84	0.7	58.8	11%
Heifers	23	0.6	13.8	22%
calves	51	0.6	30.6	2%
sheep	186	0.1	18.6	15%
Goat	49	0.1	4.9	7%
horse	82	0.8	65.6	11%
Donkey and mule	18	0.7	12.6	2%
TOTAL	783	4.31	288.53	100%

Source: Own survey, April, 2014

There are several reasons that a household keeps livestock. The primary purposes of herding livestock include provision of draught power, production of dung to use for bio-fuel and production of compost/manure to fertilize farmlands, a form of capital accumulation serving as security against emergencies, to fulfil social obligations such as gift, and provision of dairy and meat products, which have a role in the household income. Therefore, livestock rearing complements crop production and crucial asset diversification mechanisms. Livestock fattening is one of the productivity enhancement mechanism of livestock in the Kebele. Commonly, oxen from farm and sheep are fattened as high income generating activities for some households. They use Nug cake (fagulo), crop residues (like straw), and hay (Tsegaye, 2012).

Table 3.6 shows the largest livestock percent is chicken 24% and the next followers are sheep 22%, oxen 15%, cows 11%, horse 11%, and etc. As observed from the value or coverage of the livestock the coverage of the cattle's are small due to the farmers lack the farm land, pasture land and the existing area is fragmented by land degradation. There is direct relationship between land availability and the number and types of livestock's. Farmers were forced to limit themselves in holding animals with low value of TLU value not to damage their environment and to full fill their daily financial demand by selling them. The existing number of live stocks in relationship of the land area is able to create land degradation in the study area according many researchers results in this country.

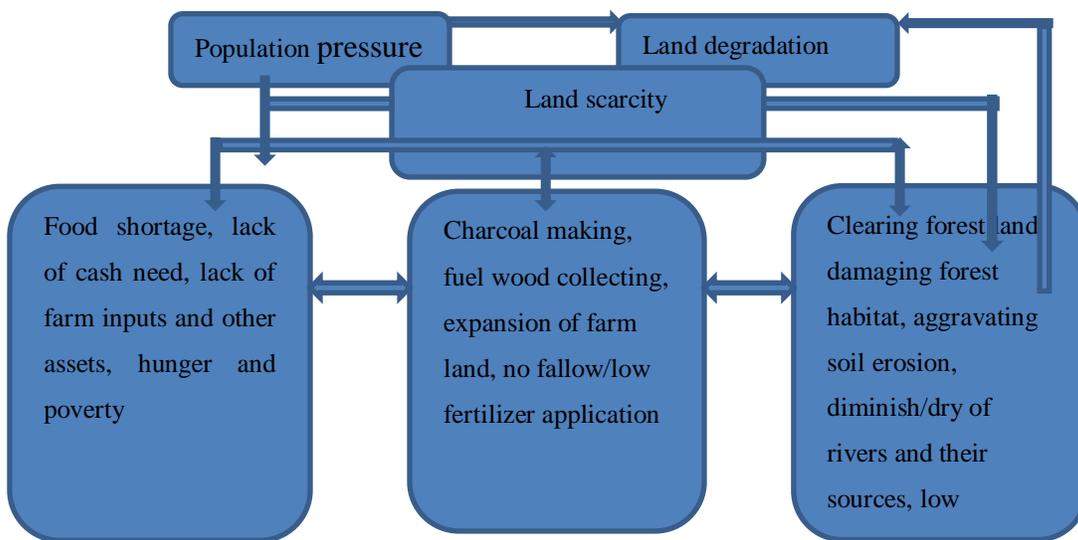
According to the key informant interviews, both the livestock population and grazing land have highly decreased in the past couple of decades and all respondents also believe the same. This is due to population increment and expansion of farmland among others. Grazing lands are converted to cropland as there is always the need to expand farm plots among land scarce farmers who are outweighing with increase in population.

The land condition of the household respondents in the study area, 58.5 % is fragmented due to farming the unfavourable land and poor managements (bad practice of tillage, poor management, and land level) and 41.5% is not fragmented relatively those who pay more attention for their lands due to their better educational status, care for their lands, and levelled

land. Condition of land status indicated that trends of land degradation which is resulted from bad practice of tillage, poor management, and land level. Therefore, the land hold system of the Toke Kutaye is relatively more degraded why that most of them difficulty to bear their family.

Figure 2 showed that the personal observation final conclusion among different factors which jointly form land degradation. These are, over population which cause farm land scarcity resulted in food shortage, and hunger, and pressure on forest areas and inducing soil erosion which finally manifested in land degradation. Land degradation derived a number of critical environmental, economic, and social issues in the area and caused stress and shock in life-support of society.

Fig 2: Cause and effect of agricultural land degradation



Source: Own conceptualization based on FGDs, April, 2014

Livelihoods are fundamentally grounded in the agricultural sector and it can be argued that poverty has its roots in the notion of access to resources and vulnerability of livelihoods to shocks. Therefore, the production and reproduction of rural poverty in the country cannot be de-linked from land and from other agricultural resources.

Over population is pushing the farmers to cultivate steep slope and neglected lands in the area for centuries. The physical characteristics of the area supported by traditional ways of land utilization had accelerated land degradation. The intensity of degradation varies from place to place in the study areas. The same result was obtained by FGD. According FGD the main problem of land degradation in the study area is scarcity of land, farming the sloppy area and less practicing of the soil and water conservation. This improper utilization of resources led to hunger, death and created ecological refuges among the young population, pasture reduction and death of their livestock's. Whether the above statement is true or not questions were given to farmers and the following results were obtained (See Table 3.3).

Anthropogenic factors affecting crop production

This model of multiple linear regression of crop productivity is used to analysis the impact of independent variables like sex of rural households, family size of rural households, education level of rural households, quintals (sacks) of fertilizer used per hectors of total lands of household, how long households worked on farm land/experience, farm land hector of rural household on the dependent variable average (crop production). Before analysing the model it was important to check the normal distribution of the dependent variable. The normality is tested by the P_P plot as depicted on figure 1 in appendix 1. The error is normally distributed; the dependent variable the average of crop production is normally

The assumptions of homoscedasticity are that error variance should be constant and the variance of the residuals is homogeneous across the levels of the predicted values. There should be no observable structure for the distribution of residuals. Due to VIF/ variable inflation factor from the table 4.10 is less than 10, so there is no problem of multi Collinearity. Table3.8 in appendix 1 show the DV and IV have weak

correlation. Again the other assumption should be raised in the analysis of the crop productivity model is the Autocorolality test/ the random disturbance or self-correlation of the qi over times for crop productivity over the time and year which is tolerable when the Durbin-Watson test value between -3.5 to 3.5 which means the average of crop productivity does not have Autocorolality problem. The other important things in table 4.9 is the R square,

75.6% the 4 independent variables (sex of household head, farm land hector, quintals of fertilizer used, and how long household worked on farm land) are significant linear relation changes in the dependent variable average crop production and the other changes are subject to extraneous variables. The variable with larger coefficient earns 75.6% units larger on average.distributed or errors are identically and independently distributed.

Table: 3.7. Model summary of regression adjusted R square

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. Change	
1	.870a	.756	.686	2.3129	.756	10.723	6	58	.000	1.212

Source: author survey, 2014

Table:3.8 Analysed model of the average crop productivity

Model	Unstandardized Coef		Standardized Coef	t	Sig.	95% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. E				Beta	Lower Bound	Upper Bound	0-order	Partial	Part	Tolerance
(Constant)	1.965E0	1.222E0		1.609E0	.020	-.480	4.411					
How long households worked on farm land	.087	.026	.413	3.311E0	.002	.034	.140	.611	.399	.299	.526	1.903E0
Farm land hector of rural households	.371	.269	.231	1.377E0	.030	-.168	.910	.625	.178	.125	.290	3.447E0
Quintals (100SKg) fertilizer used per hectors of total lands of hhs	.515	.335	.230	1.536E0	.048	-.156	1.186	.617	.198	.139	.365	2.742E0
Education level of rural households	-.172	.156	-.118	-1.104E0	.274	-.485	.140	.096	-.143	.100	.718	1.393E0
Sex of rural households	-.701	.906	-.076	-7.736E-1	.042	-2.515	1.113	-.113	-.101	-.070	.840	1.190E0
Family size of rural households	-.044	.114	-.040	-3.849E-1	.702	-.272	.184	.256	-.050	-.035	.753	1.328E0

Source: Author survey, 2014

a. Dependent Variable: Average quintals of food grain produced per hector of hhs farm land

Hence, the reduced model of the regression analysis is found to be:

$$Y = 1.222 + 0.41x_1 + 0.231x_2 + 0.23x_3 - 0.076x_5 + \epsilon_i$$

The reduced regression model indicates that the household long experience is more food production than that of short experience, the high experience of farmer change their production productivity to the unit of 41%. The average of crop production increases with the change of unit of size of farm land

per hector in 23.1%. The more quintals of fertilizer used the high yield production but incurs the more costs, the more use of the unit of fertilizer of *Quintals* (100^sKg) the more production yield by 23% and the sex of HHs per head is also have negatively impact on crop production, The male household head produce

more production relative to the female household head by 7.6% changes in the unit of crop production.

The two variable, education level and family size of HHs are insignificant because the p-values are greater than 0.05, whereas the four variables are significantly determining the crop production.

The other important things in table 4.10 are part which indicated the variance distribution of the significant predictors in determining the total variance in crop production. Experience of HHs, farm land hector size, Quintals of fertilizer used and sex of HHs are each uniquely explained 8.9%, 1.6%, 1.9% and 0% of the variance in total crop production

The finding of Muia and Ndunda (2013) also support this finding by saying that there are a lot of factor that affect the crop production among them the major are fertilizer, climate condition, way of managements and farm size and type, pests and soon.

IV. CONCLUSION AND RECOMMENDATIONS

The case study was conducted in mid highlands of Ethiopia, Toke Kutaye Woreda of the West Shewa Zone in Oromia Regional State. It was undertaken on the impact of land degradation on livelihoods of peasants. The land degraded communities are found to be varied in terms of their agro-ecologies and gender (FHHs, MHHs). The investigation was undertaken with the main objectives of identifying the major cause of land degradation, assessing the impact of land degradation on livelihoods, and identifying adaptation measure of soil and water conservation of land degradation in the Woreda. For achieving these objectives, mixed approaches of both qualitative and quantitative research methodologies were employed.

A key finding of this study is that the farmers pursue a diverse range of livelihood strategies in addition to agricultural activities. Importantly, the study of the impact of land degradation on livelihoods could benefit farmers focusing more on soil and water conservation measure to reduce the impact of land degradation on their livelihood directly or indirectly influence agricultural activity and NRM through their impact on economic and social well-being. Acknowledging farmers 'participation in a range of livelihood strategies can assist in developing a more complete picture of livelihood portfolios of land degradation cause and impacts, and their social and economic circumstances

Conclusion of this study can be summarized as follow:

The major cause of land degradation that influence the livelihoods of the rural people economy like soil erosion by heavy rain which facilitated by farming sloppy area, clearing forest land for cultivation due to raising of human population in the area, low level of education resisting to accept the new packages of soil and water conservation measure and sustainable management of natural resources.

There are a number of shocks and stresses that trigger livelihood diversifications among the farmers in both communities though farmland shortage is the top most important of all as access to it could have positive effect on others. Factors like soil degradation, population pressure, deforestation, low

level of rural economy diversifications have complicated and, directly or indirectly, contributed to land scarcity as result land degradation.

Finally, practicing the major soil and water conservation both physical and biological conservation rather than practicing only alone few of construction of canals, terrace, inter cropping and other in combination to manage the soil fertility, increase crop production and managing natural resources to maintain safe environment, reduce climate change and in general reduce/halt land degradation increase the economic growth of the country as whole.

The main Factors that affecting the crop production of the study area are land degradation which including soil erosion, deforestation, reduction of productivity, reduction of pasture land which affect the crop production of the particular area and the economy of the country as whole. Other related factors like farm land size, education level, sex of household heads, experience of farmers, family size and quintals of fertilizer are also used the most issues underlined to contribute for crop production. The strategies practiced prior by government to tackle the problem is the soil and water conservation measure to some extent but not fully practiced due to the fact that people have not full knowledge about it, the extension agents do not continually follow them due to the area lacks roads, even though the people not engaged to another activity outside of agriculture they sale wood and charcoal for surviving themselves and their family (WoRD, 2014).

If the problem is not solved in short period of time the people of the area rests into lack of enough food/food insecurity, climate change, total loss of soil fertility, hunger, gully formation, fragile land, decertification, poverty. The crop production of the target group is affected and in general the socio-economic, politics of the county is distorted. Land degradation by-product of environmental changes, has been factor that results in increasing the likelihood of migration, decreasing soil productivity, increasing price of farming inputs, and decreasing arable land area, all of which decrease a household's ability to provide sufficient livelihood for their family, thus, increasing the risk of outmigration, reduction of agricultural productivity, lack of enough food, reduction of economy, expansion of poverty, starvation etc. (Hunnes, 2012).

Recommendations

Based on the above findings and lessons drawn from the impact of land degradation on livelihood strategies of the peasants and the need to alleviate adverse effects on the natural resources of the Woreda, the key remarks are made. As the major limiting factor of the sustainable utilization of local natural resources is land scarcity, which is depleting natural resource base, the following amending actions should be taken.

The roles of non-agricultural activities (NAA) are critical to address some of the key problems of agricultural land scarce peasants and minimize natural resource degradation. Thus, policy makers and NGOs should give due attention to promote and support NAA.

Promote regional environmental cooperation in addressing climate change, migration and Deforestation-LD: Issues of climate change and migration are regional in nature, and as such

should not only be managed at the national level, as is most commonly the case today.

Use land degradation risk to prioritize investments and build donor commitment to long-term engagement in the Study area: Addressing climate change impacts on livelihoods requires long-term financial commitment and improved coordination of investments. Identified land degradation risk from climate change impacts on livelihoods and food security can help prioritize programming and funding in the region. Existing climate change adaptation funding sources – such as Green Climate Fund, the Adaptation Fund and the Clean Development Mechanism (CDM) should be used to address the emerging issues (UNEP et al., 2011).

Therefore, the study has contributed to the collective understanding of how human, bound together in economic units called households, alternatively adopt different livelihood strategies, and respond to resource constraints, specifically agricultural land scarcity, and influencing the natural resource base - land degradation in the case study area. Improving the educational level of household members can allow the family unit to make the right choices about their livelihoods, including access to new technologies to use the existing land more efficiently; adoption of new varieties to enhance crop productivity; and family planning to reduce the pressure on limited resources. Creating opportunities for rural off-farm and non-farm employments absorb a big share of landless, thereby fostering diversifications of income sources for the households.

ACKNOWLEDGEMENTS

We want to Acknowledge Adama Science and Technology University for financial support for carrying this research work.

REFERENCES

- [1] Action for Social Advancement [ASA] (2003). Land Degradation and Its Impact on Livelihoods of Tribals of Jhabua, Gujarat, India
- [2] Baylis, K., Jolejole, M. and Lipper, L. (2012). Land Degradation's Implications on Agricultural Value of Production in Ethiopia: A Look inside the Bowl. Presentation Papers at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguacu, Brazil, 18-24 August 2012.
- [3] CSA and IRP-CNR. (2001). Population Growth and Environment in Ethiopia. In Depth Studies from the 1994 Population and Housing Census in Ethiopia, Italian Multi-bi Research Project eth/92/p01 Addis Ababa, Ethiopia; Roma, Italy.
- [4] D'Alessandro, S. (2006). Non-linear Dynamics of Population and Natural Resources: The Emergence of Different Patterns of Development, University of Siena, Italy.
- [5] D.L. Johnson and L.A. Lewis Land Degradation: Creation and Destruction, 2nd edition, Rowman and Littlefield, Lanham, Boulder, New York, Toronto, Oxford, 2007.
- [6] Dong, C., Liu, X. and Klein, K. (2012). Land degradation and population relocation in Northern China. *Journals of Asia Pacific Viewpoint*, Vol. 53, No. 2, ISSN 1360-7456, pp163-177
- [7] Environment for Development [Efd] (2008). Social Capital and Institutions in Rural Kenya. Unpublished Discussion Paper Series March 2008, Nairobi University, Kenya.
- [8] The Federal Environmental Protection Authority [FEPA]. (2004). Guidelines on Soil Conservation on Cultivated Land, Addis Ababa, Ethiopia.
- [9] Food and Agriculture Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD) and the World

Food Programme (WFP). (2013). The State of Food Insecurity in the World 2013. The Multiple Dimensions of Food Security: ISBN 978-92-5-107916-4, Rome.

- [10] Getachew, A. (2005). Determinants of Land Degradation in the Lake Tana Basin and its Implications for Sustainable Land Management: The Case of Angereb and Gish-Abbaya Watersheds. Unpublished MSc. Thesis, Haramaya University, Ethiopia
- [11] Hunnes, E. (2012). Understanding Rural-to-Urban Migration in Ethiopia: Driving Factors, Analytical Frameworks, and Recommendations, First Aid World Wide.
- [12] Intergovernmental Panel on Climate Change [IPCC]. (2001). Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, A Special Report on Working Group I and Working Group II of the Intergovernmental Panel on Climate Change. Retrieved from <http://www.ipcc.ch/ipccreports/ar4-syr.htm> at September 11, 2013.
- [13] Internal FAO (2006). Assessment of land use pressure, state and response in sub-Saharan Africa, Ethiopia
- [14] Kefi, M. and Yoshino, K. (2010). Evaluation of the Economic Effects of Soil Erosion Risk on Agricultural Productivity Using Remote Sensing: Case of Watershed in Tunisia. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Science*, Volume XXXVIII, Part 8, Kyoto Japan, University of Tsukuba, Japan.
- [15] Morgan, R. (2005). Soil Erosion and Conservation Text Book, 3rd ed. National Soil Resources Institute, Cranfield University
- [16] Muia, K. and Ndunda, E. (2013). Evaluating the Impact of Direct Anthropogenic Activities on Land Degradation in Arid and Semi-arid Regions in Kenya. *Wudpecker Journal of Agricultural Research*: Vol. 2(6), pp. 173 – 182, ISSN 2315-7259, Kenyatta University, Kenya
- [17] Musa, D. (2008). Introduction to Agro- Climatology Educational Text Book. In Ologunorisa, E. (Ed) National Open University of Nigeria, Lagos, ISBN: 978-058-233-9
- [18] Olsson, L., Eklundh, L., Ardö, J. 2005. A recent greening of the Sahel— trends, patterns and potential causes. *Journal of Arid Environments* 63(3): 556-566.
- [19] Reta Hailu (2010). Livelihood Strategies among the Agricultural Land Scarce Peasants in the Central Highlands of Ethiopia- Implications on Natural Resource Base: A Case Study from Tole Woreda, Southwest Shewa. Unpublished MA thesis, Addis Ababa University, Ethiopia
- [20] Tsegaye, M. (2012). Vulnerability, Land, Livelihoods and Migration Nexus in Rural Ethiopia: A Case Study in South Gondar Zone of Amhara Regional State. Unpublished master thesis international institute of social studies, Hague, Netherlands
- [1] United Nations Convention to Combat Desertification [UNCCD]. (2013). Economic Assessment of Desertification, Sustainable Land Management and Resilience of Arid, Semi-arid and Dry Sub-humid Area. In Westerberg, V., Olsen, N., Stoeckli, V., Jaquet, S., Roth, A., David, E., Baker, L., Castillo, V. and Shim, K. (Eds.), 2nd Scientific Conference of United Nations Convention to Combat Desertification and Global Risk Forum Davos, ISBN 978-92-95043-65-7, Bonn, Germany.
- [21] United Nations Environmental Program [UNEP], International Organization for Migration [IOM], Office for the Coordination of Humanitarian Affairs [OCHA] and Permanent Interstate Committee for Drought Control in the Sahel [CILSS]. (2011). Livelihood Security, Climate Change, Migration and Conflict in the Sahel, ISBN: 978-92-807-3198-9, Salzburg's Centre for Geoinformatics University
- [22] WoRD. 2012. Woreda of Rural Agricultural Development of Toke Kutaye, Unpublished Report, Oromia.
- [23] World Meteorological Organization [WMO] (2005). Climate and Land Degradation. Climate Information – Resource Conservation – Sustainable Management of Land, WMO, No. 989

AUTHORS

First Author – Feyera Deresa, Mizan Tepi University, School of Agriculture and Natural Resource, Department Of Natural Resource Management, <deresafeyera@gmail.com>

Second Author – Tsetadirgachew Legesse, Adama Science and Technology University, School Of Humanities and Law,

Department Of Geography and Environmental Management,
email,tyybet@gmail.com Plus correspondence Author ,contact

number 0912037694

Hostel Facility Maintenance Preliminary Finding of Higher Education Institution in Malaysia

Yuseni Ab Wahab¹, Abd Samad Hasan Basari²

¹ Faculty of Business Innovation and Accounting, Kolej Universiti Islam Melaka (KUIM), Kuala Sungai Baru 78200, Masjid Tanah, Melaka, yuseni@kuim.edu.my

² Centre for Advanced Computing Technology (C-ACT), Faculty of Information & Communication Technology, UTeM, Hang Tuah Jaya, 76100, Durian Tunggal, Melaka, abdsamad@utem.edu.my

Abstract- Hostel Facility Maintenance (HFM) is essential to prolong the hostel building life cycle and reduce the company loss. When hostel buildings are neglected, defects can occur which may result in extensive and unavoidable damage to the building fabric or structure. The objective of this study is to identify Higher Education Institution in Malaysia (HEIM), case study Kolej Universiti Islam Melaka (KUIM) focus on preliminary finding in hostel facility maintenance problems. As such, the chosen facility maintenance building needs to be identified before the research start. The defect and the problem face will be collected and noted in a check list. This will be done by questionnaires and distributed to all service users in KUIM building maintenance management office and student hostel. Interview sessions and site visit are also conducted to understand the problem encounter. Hence, this paper is focusing on the maintenance management system which the aim is to reduce the downtime of plant items taking into account the possible impact of a failure in terms of cost. The analysis shows that the Hostel Facility Maintenance contributed to the most problematic area in KUIM. Based on the preliminary finding, it shows that there is a need to propose a systematic in Hostel Facility Maintenance.

Index Terms- Hostel Facility Maintenance; Analyse of breakdown, downtime and cost

I. INTRODUCTION

Maintenance is defined as a combination of technical in addition to administrative activities causing the actual safety in addition to satisfactory function regarding tool repair involves many methods from standard cleaning in order to fixes in addition to substitutions. . It can be as small as changing a washer to stop a leaking tap, or as large as repainting an entire building. Beneficial repair allows retain the value of the building and makes the property more enjoyable to occupy. Forget about regarding repair also can be a hearth in addition to safety risk to safety that could cause becoming officially chargeable for just about any accidents[1],[2].

II. TYPE OF MAINTENANCE

Maintenance may be labeled according to why and when it happens, and also consists of:-

a) Corrective maintenance - to keep the building at an acceptable standard. This includes cleaning gutters and

changing light bulbs. Corrective maintenance would normally be carried out by the occupant.

- b) Predictable (planned) maintenance - to prevent predictable failure of building infrastructure or capital items. This includes repainting surfaces or replacing roof cladding at the times specified by product manufacturers.
- c) Emergency corrective maintenance - must happen immediately for health and safety or security reasons. This includes work that may result in the rapid deterioration of the structure or fabric if unattended to immediately. Such includes roof repairs after cyclones, graffiti removal or repair of broken glass.

A repetitive process is needed in order to provide adequate maintenance. A maintenance plan will ensure the correct approach is carried out and any shortfalls are discovered and corrected in a timely manner. Maintenance includes the required processes and services carried out to preserve, repair, protect and care for the building's fabric and engineering services after completion, repair, refurbishment or replacement to current standards to enable it to serve its intended functions throughout its entire lifespan without drastically upsetting its basic features and use [3],[4].

The premise for this study is the move from the building and its management as the main focus for the maintenance management process towards the value chain (enhance productivity and user satisfaction) as the main focus. The value chain is the focus for more effective and efficient strategy of creating value to maintenance organization and building users. Value creation is increasingly viewed as a process of facilitating a network of relationships within which organizations are positioned [1, 5]. The deficiencies in the practices could be due to the way the policies are framed, how they are being understood or how they are enforced. Good maintenance management should be simple, dynamic, and capable of periodic review as the need arises to accommodate technological advancements and the clients' and users' value systems [3]. When developing a maintenance management system, users (and client-occupiers) must be involved to ensure that their satisfaction is proactively taken into account while formulating the maintenance policy. In addition, the current proposals depend on the physical conditions of the building to establish the maintenance need and, therefore, are conditional based. Conditionally based maintenance is not a proactive maintenance policy. At best, all that a condition-based maintenance policy does is to provide a snapshot of the physical condition of the

building at the specific time that the survey was conducted. Conditionally based maintenance policy is not explicitly linked to the ability of a building to support organization performance [5],[6]. The physical condition of a building is just a symptom of defects, deterioration, or decay, or their combination. Under the current approaches to buildings maintenance, maintenance is not factored as a factor of production, which also leads to the fragmentation of the building management processes [7].

III. PROBLEM STATEMENT

There is an evident that a part of maintenance records coming from complaint and demand from user. Several drawbacks are listed below:

- a) Maintenance schedule that not properly made for building maintenance.
- b) There is lack of study and prediction to overcome building maintenance.
- c) Unsystematic plan to reduce downtime of building items or reducing maintenance and inspection costs, taking into account the possible impact of a failure in terms of cost to the company.
- d) Improve study is conducted on subjective measure of the consequences of such a failure in terms of cost, in monetary value to the company and the damaging effect to the company.

IV. RESEARCH OBJECTIVES

The main objectives of this research are as follows:

- 1) To investigate the problem of hostel facility maintenance in KUIM.
- 2) To analyze the number of breakdown, downtime and cost in KUIM facility maintenance.

V. SCOPE

University buildings usually are one of several components to make a top quality student. The actual buildings usually are procured to make a acceptable, conducive in addition to ample environment which helps, induces in addition to encourages learning, educating in addition to innovative developments. A failure within the availability of these kinds of vital products and services can be a reduction throughout importance towards university institution, the community, the particular University students, staff members as well as other stakeholders. Naturally simply by making brand-new buildings is usually helping to improve educational institutions and supply better top quality knowledge; however, it really is most important to maintain of the existing buildings to meet a satisfactory top quality standards which can handle facilitating the particular shift involving knowledge in addition to undertaking various other instructional things to do properly in addition to efficiently. This study is usually concentrating on KUIM constructing especially about KUIM hostel [7],[8].

VI. RESEARCH DESIGN

Figure 2.1 is a flowchart of the research design.

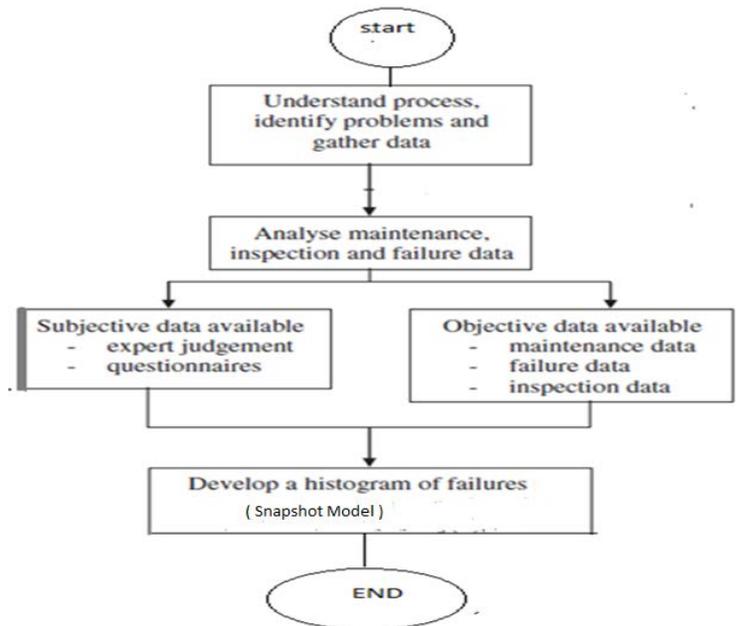


Figure 2.1. Flowchart of the research design

VII. UNDERSTAND THE PROCESS

Before the development of any maintenance model, a thorough understanding of the processes involved is essential. Insufficient or inadequate work in this area will almost certainly spell disaster in the task of understanding the problems of a company. When understanding a process it is equally important to consider the tasks carried out at inspection as well as during maintenance. It may be the case that there are several parts that fails regularly might be overlooked because it is inexpensive to correct.

VIII. IDENTIFY THE PROBLEMS

Many approaches applying risk-based research can be useful in this particular step in the review such as event tree analysis (ETA) or failure mode and effects analysis (FMEA). Snapshot model [5, 8] is usually a kind of hierarchical research in which just about all feasible problems are categorized straight into distinct levels along with teams. ETA can be used to discover different feasible benefits, granted a commencing event. Certainly one of this is a portion declining, supplying indication to a part of products or maybe course of action pots even more research. FMEA may discover feasible failing modalities and also the outcomes about the method however could also provide a likely seriousness towards the influence, this particular being handiest when investigating environmentally friendly or maybe safety vital items. Obtaining verbal to upkeep professionals, manufacturing professionals along with crucial retail outlet ground workers, a comprehensive perception of the process really should now possibly be feasible. Difficulties including prolonged equipment failures, specifically when it comes to high-volume products really should just about all become

noticeable. Treatment must be consumed concerning whether a failure is often a upkeep concern instead of a anatomist concern or maybe agent concern. Certainly one of a anatomist concern may be attempting to a completely wrong illustrating or maybe method, a agent concern may be undertaking of your process applying completely wrong tooling or maybe using a device at a better charge in comparison with it turned out at first made to manage. Once the crucial place items are acknowledged in addition to a listing of predominant problems of this particular object, data will then possibly be compiled.

IX. ESTABLISH REQUIRED DATA

Data can come in many forms from maintenance departments and more often than not be extremely detailed; however, for the purposes of producing a maintenance model, this information is often unusable. The majority of data gathered by maintenance departments are generally the name of the equipment or the part number to have failed, the repairs made including spare parts used and the time the repair or inspection has taken to return the equipment to production. Therefore, the type of data collected is important along with some basic assumptions for the equipment or component investigated. The types of data required for a maintenance model are as follows:

- a) Average downtime due to inspection, *d*.
- b) Average downtime for a breakdown repair, *db*.
- c) Arrival rate of defects per unit time, *kf*.
- d) Inspection period, *T*.
- e) Failure rate l (1/MTBF).

Downtime due to inspection, *d* is the amount of time, on average, an inspection will take to complete and return the equipment to production. The average downtime due to a breakdown and subsequent repair of the equipment *db* is the time it takes on average to return the equipment to production. The units of both downtime inspection and breakdown repair downtime must be identical but can be measured in hours, days or months depending on the equipment under investigation. The arrival rate of a defect, *kf* is the average time a defect arises over a period of time, calculated by the number of defects divided by the total operating time of the equipment under investigation. The inspection period is simply the time interval between inspections. Failure rate l is the reciprocal of mean time between failures (MTBF), where MTBF is the mean operating time between failures of a component or piece of equipment. MTBF, however, should not be confused with the delay-time of a component or a piece of equipment. The delay-time is the time from an initial telltale sign of failure to actual failure, both being dependant on the inspection interval, *T*

X. GATHER DATA

The question as to whether a maintenance model is carried out using either subjective means or objective means is dependent on what data are available. If maintenance records of inspections carried out with details of failures encountered are available, then an objective maintenance model can be used to

estimate the delay-time. If however these types of data are not available, then subjective maintenance model must be used. This can be achieved by gathering information from sources such as the maintenance team, operator personnel and management through the use of questionnaires. It has been previously suggested that the number of experts to use is in the region of 3–5 for subjective maintenance model. The consistency of the data is another aspect to consider when gathering data. There could be several sources of data available for a piece of equipment, giving different signals regarding completeness and accuracy of data, which could develop into a time-consuming activity to sort the valid data from the irrelevant data.

XI. OBJECTIVE DATA ANALYSIS

Objective maintenance model requires maintenance data as well as failure and inspection data in order to estimate the values of the parameters that will indicate the arrival rate of a defect l and the delay-time distribution.

XII. SUBJECTIVE DATA ANALYSIS

It has been documented that the delay-time concept as part of subjective data analysis to establish maintenance model is not as straightforward to understand by engineers and operators as first imagined during the study of equipment at a company. Therefore care needs to be taken when developing questionnaires or interrogating inspection data. To help avoid confusion when trying to implement a maintenance model to a manufacturing environment, the term ‘how long ago’ (HLA) and ‘how much longer’ (HML) can be used. The term HLA is a means of establishing from an engineer or a technician how long ago the fault could have been detected. The problem with asking for an estimate for HLA is that possible blame could be leveled at the individual for not identifying the hidden fault at an earlier inspection; therefore, care needs to be taken and trust gained when establishing HLA and HML figures. The delay-time, *h* can be calculated by adding the HLA and HML together.

XIII. ADVANTAGES AND DISADVANTAGES

There are several advantages and disadvantages for using the subjective maintenance model method for estimating a delay time for a plant or equipment establish maintenance model. The main advantage with subjective maintenance model is that limited failure data are required in order to establish a delay-time estimate, one simply relies on the expertise of the personnel involved with the running of the equipment; moreover, if the majority of maintenance and inspection data existing is unusable, then a means of establishing figures for the required parameters needs to be established even for objective maintenance model [11,12]. There are however some disadvantages with this method, one disadvantage being that if a lack of faults or failures of the equipment in question is infrequent, then it may take some time to gather enough data for subjective maintenance model to be viable. A second disadvantage is that it can be time consuming. The time to compile and issue the questionnaire to ensure that all staff involved in the process has an understanding

of the delay time concept. Understanding the delay-time concept has previously proved to be a tough challenge; therefore, the content of the questionnaire is of vital importance in order to avoid lengthy sessions with relevant experts explaining the questionnaire or gathering inaccurate data. In addition to establishing HLA and HML figures, there are other questions that need to be addressed, namely:

- a) How many failures do you experience each working day/week/month?
- b) What is the average downtime for each failure?
- c) How many faults have been identified at each inspection?
- d) Please give a brief description of the failure and fault.
- e) Is the failure or fault preventable?
- f) If the failure or fault is preventable, briefly describe how.

XIV. CASE STUDY

The case study is conducted at KUIM Hostel Building. The analysis is conducted by snapshot model (Basari, ASH ,2009) The type of analysis includes :-

- a.) Major fault analysis
- b.) Downtime analysis
- c) Cost analysis

XV. MAJOR FAULT ANALYSIS

Major fault analysis. - Major fault analysis is one of the main components of KUIM building analysis the critically of the components of the building can be assessed by looking at the frequency of the type of the faults occurred within the component. Details of the result could be seen in Table 3.1. The cause of fault analysis is really necessary and important in assessing the performance of the maintenance procedure and directions to which is needed to be completed. For example if the cause of fault is due to operator practice then the need of proper training and replace new component is likely reducing the number of faults or breakdowns[9],[10].

Table 3.1 Number of Faults by Cause of Faults and their Percentages for the Period from January 2012 to June 2012

	CAUSES OF FAULTS								TOTAL FAULT	PERCENT
	Jammed	Broken	Leak	Age	Poor design	Burn	clogged	Other		
TOTAL FAULT	24	126	55	0	23	0	13	5	8	100%
COMPONENT NAME/ AREA OF FAULT										
Door	18	102			2				120	48.8
Water pipe			3		1		5	2	11	4.5
Sliding door	4		11						15	6.1
Toilet		15	7		7		5	3	40	16.3
Ceiling		4	8		6				18	7.3
Window	2	1	18		1				23	9.3
Sink		3	7		6				16	6.5
Table	2	1							3	1.2
PERCENT	9.3	51.2	22.4	0	9.3	0	5.3	2	246	100%

Figure 3.1 shows the total number of faults and detected faults. Details of the result could be seen in this figure and the result, Two worst components which are counted about 48.8% and 65.1% of the faults are Door and Lamp from other component . The major cause of faults that highly affected the maintenance in term of cost is broken for the both component.

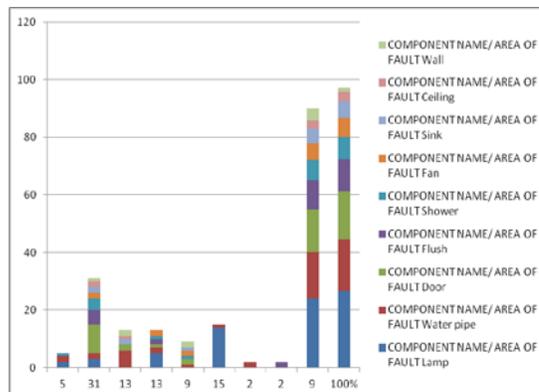


Figure 3.1 Numbers of Faults by Area and Cause of Faults for the Period from January 2012 to June 2012

3. 2 *Downtime analysis* - The term downtime means the time that an item of equipment is out of service, as a result of equipment failure. The downtime analysis aims to evaluate the performance of the equipment in term of its availability [13]. In this study the downtime is taken to be equal to the summation of the following times:

- The diagnosis time
- The repair time
- The waiting time for the technicians if there are no technicians at the time of the equipment failure
- The waiting time for the materials if there are no spare parts at the repair time.

Table 3.2 Estimated Total Downtime by Area and their Percentages for the Period from January 2012 to June 2012

	CAUSES OF DOWNTIME								TOTAL FAULT	PERCENT
	Jammed	Broken	Leak	Age	Poor design	Burn	clogged	Other		
TOTAL FAULT	600	2,400	336	0	312	0	408	0	8	100%
COMPONENT NAME/ AREA OF FAULT										
Door	288	1,800			120				2,208	55.8
Water pipe		152	72	144			24		492	10.7
Sliding door	72	21							93	2.4
Toilet		336	48		120		336		840	20.7
Ceiling		72	24		40				144	3.5
Window		24	72						96	2.4
Sink		72	48		24		48		192	4.7
Table										
PERCENT	34.8	59.2	8.8	0	7.7	0	30	0	4,056	100%

Figure 3.2 depicts the estimated downtime by area and cause of faults. Table 3.2 shows the estimated downtime by area and their percentages. From the result, three worst components according to their cause of faults and associated downtime are Wall and Shower. The following observations can be concluded:

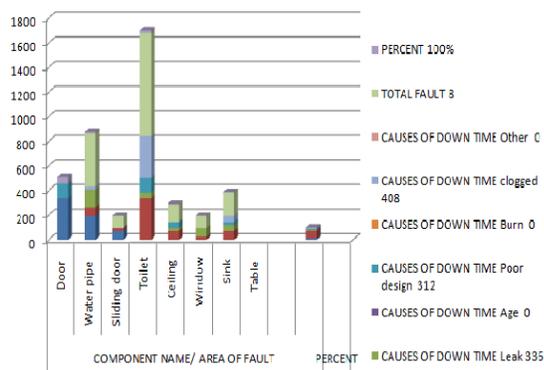


Figure 3.2 Total Downtime by Area and Percentages for the Period from January 2012 to June 2012

The aim of this analysis is to assess the severity of the faults that have occurred in term of downtime and the cost incurred. In this study the cost is taken to be equal to the cost of the technicians or contractors who carried out the diagnosis and repair of the building plus the cost of the materials if spare parts are used, and plus the production lost cost due to the disruption of the work. Table 3.3 shows the total estimated cost by area and cause of faults.

Table 3.3 Estimated Total Cost by Area and their Percentages for the Period from January 2012 to June 2012

	CAUSES OF FAULTS								TOTAL FAULT	PERCENT
	broken	Age	Leak	Poor design	Burn	clogged	Other	Leak		
TOTAL FAULT	RM125	RM13175	RM125	0	RM1375	0	RM10	0	3	100%
DOOR	RM170	RM10125			RM125				RM10270	76.82
Water pipe	RM120	RM1	RM13175				RM10		RM13196	1.84
Sliding door	RM13	RM120							RM133	1.12
Toilet		RM13175	RM125		RM125		RM10		RM13400	22.79
Ceiling	RM10	RM10	RM10		RM10				RM40	0.4
Window	RM10	RM10	RM10						RM40	0.36
Sink	RM120	RM10			RM10		RM10		RM150	2.27
Table										
PERCENT	0.37	34.77	1.44	0	10.38	0	0.38	0	15.178	100%

Table 3.3 show the total estimated cost by area and cause of faults. From the result, two worst components according to their cause of faults and associated cost are Door and Fan. The major cause of faults that highly affected the maintenance in term of cost is broken. For Door, the decreasing rate are from RM 13 770 to RM 10 125. As for Fan, the decreasing rate are from RM 1 755 to RM 675.

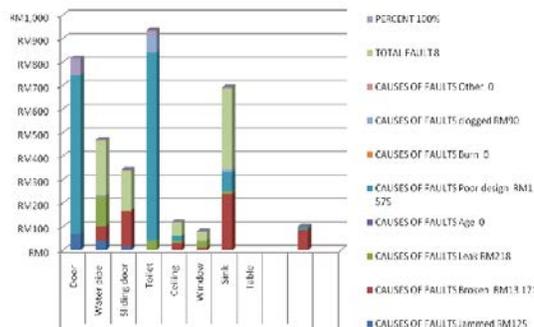


Figure 3.3 Estimated Total Cost by Area and Cause of Faults for the Period from January 2012 to June 2012

XVI. CONCLUSION AND DISCUSSION

Building Maintenance management for KUIM consists of managing, planning and also controlling the building maintenance. In spite of that there are four supporting factors that need to be considered in making KUIM building maintenance management more effective and efficient when it is executed. The Organization structure and general responsibilities of maintenance management.

- a) The maintenance policies and standard for maintenance.
- b) The maintenance management planning and scheduling.
- c) The maintenance management for budgeting and cost controlling.[4]

Therefore, there is a deficiency in the ways in which building’s maintenance procedures are being managed. Various attempts have been made to improve the performance of buildings through maintenance. While such schedule procedures offer the potential to improve the performance of maintenance management systems, the systems have, however, been reactive, hypothetical, and conditionally based. It is these substantial weaknesses in the proposed schedule procedures that have created the fundamental problems with the existing and proposed building maintenance management schedule procedure, causing their inability to improve the existing systems. Maintenance cannot be circumvented, but what is possible is that expenditure on building maintenance can be optimized through a proactive maintenance management system based on the concept of value[11],[12].Users measure the performance of their building in terms of various criteria that are consistent with their value systems. Maintenance management procedures must be based on the user’s value systems. A significant impetus of value-based maintenance management is the progressive realization that maintenance must be viewed from engineering, scientific, technological, political, and commercial perspectives. [13],[14].The proposed research to KUIM maintenance management is focusing on the field inspection and condition assessment for educational buildings. KUIM can develop an approach that uses the available maintenance data and resources to predict the condition of components and prioritize them for inspection purposes which identify and investigate the defects, symptoms, and interrelationships among top building components [11].

ACKNOWLEDGEMENTS

This research is part of Degree of Doctor of Philosophy (PhD) in the Faculty Information and Communication Technology, Universiti Teknikal Malaysia Melaka (UTeM).

REFERENCES

- [1] Olanrewaju, A. (2010) Case for alternative approach to building maintenance management of public universities. *Journal of Building Appraisal* 5: 201–212.
- [2] Basari, ASH (2009). *Maintenance Modeling Tools with special to Incomplete Data*, Phd Thesis, Universiti Teknikal Malaysia Melaka (UTeM), Malaysia
- [3] Y. Ab Wahab and A.S.H. Basari, "Analysis of down time and reliability estimation in hostel building maintenance-a case study," *Middle-East Journal of Scientific Research*, vol. 17, no. 9, pp. 1260-1268, 2013.
- [4] Y Ab Wahab, ASH Basari, A Samad, "Building Maintenance Management Preliminary Finding of a Case Study in IcyM," *Middle-East Journal of Scientific Research* 17 (9): 1260-1268, 2013
- [5] Masood Bamadi, "A Review on Education of Dentistry," *Middle-East Journal of Scientific Research* 18 (7): 878-886, 2013
- [6] Sharkul Taubaeva, Ajgul Bulatbaeva, Yuri Bogatyrev, Alexander Demytyev and Bakhit Barsay, "Study of the Educational Space of a Higher Military Educational Establishment," *Middle-East Journal of Scientific Research* 21 (1): 51-55, 2014
- [7] Amaechi Udefi, "The Trouble with Nigerian Universities, the Menace of Bogus Policy and Speculative Ideology" *Middle-East Journal of Scientific Research* 21 (5): 855-869, 2014
- [8] B. Jones, I. Jenkinson, and J. Wang, "Methodology of using delay time analysis for a manufacturing industry," *Reliability Engineering & System Safety*, vol. 94, no. 1, pp. 111–124, 2009.
- [9] W. B. Wang, D. Banjevic, and M. Pecht, "A multi-component and multi-failure mode inspection model based on the delay time concept," *Reliability Engineering & System Safety*, vol. 95, no. 8, pp. 912–920, 2010.
- [10] W. B. Wang, "Delay time modeling," in Murthy DNP, Kobbacy AKS, Ed. *Complex system maintenance handbook*, Amsterdam: Springer; pp. 345–70, 2008.
- [11] Yuseni Ab Wahab, Abd Samad Hasan Basari, 'Replacement Model for Higher Education Institution Hostel Building Maintenance in Malaysia' *International Journal of Trade, Economics and Finance*, IJTEF 2014 Vol.5(5): 449-453 ISSN: 2010-023X October 2014
- [12] Y Ab Wahab, ASH Basari, B Hussin Replacement Model for Hostel Building Case Study: ICYM, Middle-East Journal of Scientific Research 21 (11): 1977-1981, 2014 ISSN 1990-9233 © IDOSI Publications, 2014
- [13] Y Ab Wahab, ASH Basari "Identifying the Best Parameter Distribution for University Hostel Building Maintenance" *Middle-East Journal of Scientific Research* 22 (8): 1145-1149, 2014 ISSN 1990-9233 © IDOSI Publications, 2014
- [14] Yuseni Ab Wahab, Abd Samad Hasan Basari. "Best Parameter of the Hostel Building Component Maintenance" *International Journal of Computer Applications* 110(15):17-20, 2015 © IJCA January 2015

AUTHORS

First Author – Yuseni Ab Wahab, Faculty of Business Innovation and Accounting, Kolej Universiti Islam Melaka (KUIM), Kuala Sungai Baru 78200, Masjid Tanah, Melaka, Email: yuseni@kuim.edu.my

Second Author – Abd Samad Hasan Basari, Centre for Advanced Computing Technology (C-ACT), Faculty of Information & Communication Technology, UTeM, Hang Tuah Jaya, 76100, Durian Tunggal, Melaka, Email: abdsamad@utem.edu.my

Potential Use of Data Mining Techniques in Information Technology Consulting Operations

Mehran Qadri, Zubair Ahmad, Jamaludin Ibrahim

Faculty of Information and Communication Technology, International Islamic University Malaysia

Abstract- The concept of data mining has been around for a while now. It is a process of extraction of useful patterns and information from huge data sets. Many tools and techniques have been developed to make use of the data mining concept in various industries. However before implementing data mining techniques or making any other key decision relating to their I.T infrastructure, the top management of a business would usually consult with an I.T consulting firm to determine the feasibility of adopting new techniques such as data mining into their business operations. An I.T consulting firm, in turn will provide the client with valuable feedback in the form of advice, or cost estimations and potential profits, or even a full-fledged plan on how to implement techniques like data mining into their business. However, the question does arise as to whether I.T consulting firms themselves should implement data mining techniques into their business operations and whether such techniques can help them to provide better services to their clients. I.T consulting firms advise clients on a range of areas related to I.T such as strategic planning, security consulting, networking, systems integration etc. This means that an I.T consulting firms has to manage and sustain a huge network of clients, partners, and service providers. This, then naturally results in a huge amount of data that is to be stored and maintained by the firm. This paper will discuss the concept of data mining, the use of data mining in other industries and its benefits, its potential use by I.T consulting firms, and whether it can help improve I.T consulting operations.

Index Terms- Business, Consulting, Data, Improvement Mining, Techniques.

I. INTRODUCTION TO THE DATA MINING CONCEPT

Plenty of data have become available within the area of scientific research, small businesses, industries and many other areas as a result of rapid innovations in computerization along with digitalization techniques. The exploration in databases and data innovation has offered ascent to a way to store and manipulate this valuable information for further decision making. Data mining is a process of extraction of useful information and patterns from huge data. It is also called as knowledge discovery process, knowledge mining from data, knowledge extraction or data /pattern analysis.

Knowledge Discovery in Database (KDD) is a core part of Data Mining. KDD and Data Mining are often interchangeable because data mining is the key part of the KDD process [1].

Big data brought on a huge increase in the use of more intensive data exploration techniques, partially because of the huge magnitude of the information itself and because the information is often more varied and large in its very dynamics.

With this humungous amount of data, it isn't any longer enough to obtain relatively basic statistical information out of your system. Having a few hundred million records of detailed information on customers, acknowledging that a few million of them live a single location just isn't enough. We want to know whether these few million are from a particular age group and what is their average income to be able to target this particular group more effectively by gauging the specific customer requirements of this group. This is exactly the kind of unique information that data mining can provide.

The data mining concept thus allows organizations to extract meaningful and competitively advantageous information from their data rather than just extracting basic statistical information.

II. KEY TECHNIQUES IN DATA MINING

There are several key techniques that fall under the concept of data mining. These techniques include: Association, Classification, Clustering and Prediction. These are the most common data mining techniques that are mentioned in various books, journal papers and articles [2] [3][4][5][6].

Association aims to establishing relationships between items which exist together in a given record [2][4][7]. These relationships are usually found using association rules between data that might seem to be unrelated at first. An example of an association rule would be, "If a customer buys an ink pen, he is 70% likely to buy an ink bottle as well". Thus in data mining, the technique of association rules can help businesses to analyze the purchasing behavior of a customer and also help to predict a customer's purchasing behavior for the future. This will allow businesses to target specific customers with specific advertisements and promotions which will allow the business to maintain sales of specific product categories and at the same time gain customer loyalty.

The classification technique aims at building a model to predict future customer behavior through classifying database records into a number of predefined classes based on certain criteria [2][4][8][9]. Association establishes the relationship between two or more seemingly unrelated items and then the classification builds on the relationship by predicting customer behavior related to those items.

The clustering technique is the task of segmenting a heterogeneous population into a number of more homogenous clusters [2][3][4]. It is basically the grouping of items into categories or “clusters” based on some common characteristics. [10] gives the following example: Consider a group of people who share similar demographic information and who buy similar products from the Adventure Works Company. This group of people represents a cluster of data. Several such clusters may exist in a database. By observing the columns that make up a cluster, you can more clearly see how records in a dataset are related to one another.

The prediction technique, also known as forecasting, is a very useful data mining technique that is able to predict the behavior of a customer more accurately than human-generated rules. The prediction technique creates profiles of users based on their personal information such as age, gender, etc. and also based on their previous shopping behavior. For example, the prediction technique might say if a person of age sixteen visits a shopping website and buys an electric guitar, then he is likely to buy an amplifier as well. This kind of technique can then be implemented to make real time recommendations to customers based on which user profile of the prediction model does the customer fit in.

We have discussed a few common data mining techniques and how they can help businesses improve their services as well as ensure their sustainability in the market. In the following sections, we will discuss how data mining is being used in other industries to improve business operations and we will discuss how the I.T Consulting Industry can potentially benefit from it as well.

III. USE OF DATA MINING IN OTHER INDUSTRIES TO IMPROVE OPERATIONS

Industries like healthcare, online businesses and insurance companies are already using data mining in their day to day operations. One example of data mining being used in the healthcare industry is a healthcare company called Carolinas HealthCare System.

Carolinas HealthCare, which runs more than 900 care centers, including hospitals, nursing homes, doctors’ offices, and surgical centers, has begun plugging consumer data on 2 million people into algorithms designed to identify high-risk patients so that doctors can intervene before they get sick[12].

The company is running its data through data mining tools like predictive models. This allows the company to keep track of a patient health and provide care in a specialized manner.

[12] gives an example using the following scenario as to how the use of the predictive models of data mining works: For a patient with asthma, the hospital would be able to assess how likely he is to arrive at the emergency room by looking at whether he’s refilled his asthma medication at the pharmacy, has been buying cigarettes at the grocery store, and lives in an area with a high pollen count. The system may also look at the probability of someone having a heart attack by considering factors such as the type of foods she buys and if she has a gym membership.

If we take a look at the insurance industry, more and more insurance companies are starting to utilize data mining tools for optimizing the prices of their products and providing a customized service to each of their customers.

According to [13], price optimization is a data mining tool that lets insurance companies figure out which groups of customers are more likely to accept a price increase and which are more likely to shop around for a new policy.

Thus an insurance company can analyze a customer’s behavior using data mining techniques and can either create a new insurance product for that specific customer or offer them a previously used insurance policy based on the analysis of their data. There is clear evidence that data mining is being used to optimize prices by more and more insurance companies.

A 2013 marketplace survey done by Earnix, a global leader in price optimization, found that 26 percent of all auto insurance companies and 45 percent of the large insurance companies (more than \$1 billion in annual revenue) in North America currently optimize their prices [13].

Thus, considering the above evidence from the healthcare and the insurance industry, we can clearly see that implementing data mining techniques is helping these industries to provide better care and services to their customers. This in the long run will help these industries to retain more and more customers and also attract new customers to the products and services being offered. Hence, there is no reason to doubt that similar results can be achieved in the I.T consulting industry if I.T consulting firms implement data mining techniques into their business operations.

In the following sections we will discuss the common operations of an I.T consulting firm and try and see how the data mining techniques discussed previously might prove to be useful in I.T consulting operations.

IV. I.T CONSULTING OPERATIONS

I.T. consulting firms typically perform two major operations: Client acquisition and delivery of services to the client. Client

acquisition involves attracting clients who are looking for consultation services regarding their I.T. infrastructure to use the services of one's I.T. consulting firm. Clients can be made aware of an I.T. consulting firms' services through various mediums. These include Television advertisements, newspaper advertisements and online advertisements. An I.T. consulting firm can also tie up with other firms to gain recognition and attract more clients. Social media is another major platform through which an I.T. consulting firm can make its presence known and acquire clients.

According to [11], In order to acquire clients, consultancy firms can offer free advice to clients to give them a taste of what their services is all about. Then they should distribute and promote them through social media networks such as Twitter, LinkedIn and Facebook, etc. along with email distribution, campaigns and free newsletters. As the consultancy firm creates credibility with their marketing strategy, they will gain more clients as a result.

Delivery of service is the main value proposition of an I.T. consulting firm. I.T. consulting firms can advise clients on a variety of issues relating to areas like strategic planning, security consulting, networking, systems integration, data analytics, business intelligence, enterprise resource planning, business process outsourcing and many more. I.T. consulting firms are also hired to plan, design, implement and maintain I.T. infrastructures.

I.T. consulting firms thus provide services covering a wide range of fields related to I.T. This results in a consulting firm having a vast network of clients, partners and service providers. Thus, an I.T. consulting firm generates and maintains large amounts of data. It is thus very much possible that this vast amount of data could hold meaningful and potentially competitively advantageous information that could help an I.T. consulting firm to improve its services.

V. USE OF DATA MINING TECHNIQUES IN I.T CONSULTING OPERATIONS

As discussed in the previous section, an I.T. consulting firm performs two major operations: Client acquisition and Delivery of services to the client. There are several potential ways in which an I.T. consultancy firm can improve its client acquisition operation by implementing data mining techniques.

To improve client acquisition, an I.T. consulting firm can implement prediction techniques on their website and on partner websites to offer potential clients with services they are most likely going to be needing. These offers can show up on a particular website in the form of recommendations, special promotions or discounts. These offers will change dynamically according to the user profile a particular user fits in. This thus will enable the I.T. consulting firm to target specific users with specific offers that they are most likely to accept.

To improve their services offered and the delivery of those services, an I.T. consulting firm can implement the data mining techniques discussed previously in combination to achieve the desired result.

Using the clustering technique, an I.T. consulting firm can create classes or 'clusters' of its clients according to one or more characteristics such as type of industry the client is from, type of service requested etc. After creating these homogenous clusters of their clients, then, using the association, classification and prediction techniques, an I.T. consulting firm can analyze its current client data and predict what kind of service is a particular client group more likely to request for. This will allow the firm to provide customized and specialized service to each client group. The I.T. consulting firm will also thus be able to target each client group with special promotions and discounts on the services the client group is most likely to request for. This customized service to each client will most definitely help to retain the client and will also serve as a means to attract new clients with the offer of customized and specialized services.

VI. CONCLUSION

In this paper, we discussed some of the common data mining techniques available. We further discussed the major operations that an I.T. consulting firm performs in its day to day business. Finally, we discussed how some of the data mining techniques that were discussed in the earlier sections could be implemented into the day to day operations of an I.T. consulting firm.

We have discussed the potential benefits of implementing such techniques such as improved client acquisition and retention, improved services in the form of targeted and customized service to each client, and attracting potential clients by offering services to them in a uniquely customized manner.

However, before embarking on the journey of implementing these data mining techniques, an I.T. consulting firm needs to keep a few things in mind. Feasibility analysis should be conducted to find out whether it is financially viable to implement such techniques. Also, the firm's data should be of a standardized format across all branches in order for data mining techniques to work. The firm thus needs to weigh the potential costs and benefits carefully against one another before making the decision of implementing data mining in their business.

REFERENCES

- [1] Yongjian Fu, "Data Mining Task, Techniques, and Applications", Department of Computer Science, University of Missouri –Rolla.
- [2] S.R. Ahmed, "Applications of Data Mining in Retail Business", Information Technology: Coding and Computing, 2, (2004), pp. 455-459.
- [3] C.G. Carrier, O. Povel, "Characterising Data Mining Software", Intelligent Data Analysis, 7, (2003), pp. 181-192.

- [4] S. Mitra, S.K. Pal, P. Mitra, "Data Mining in Soft Computing Framework: A Survey", *IEEE Transactions on Neural Networks*, 13, (2002), pp. 3-14.
- [5] M.J. Shaw, C. Subramaniam, G.W. Tan, M.E. Welge, "Knowledge Management and Data Mining for Marketing", *Decision Support Systems*, 31, (2001), pp. 127-137.
- [6] E. Turban, J.E. Aronson, T.P. Liang, R. Sharda, *Decision Support and Business Intelligence Systems*, Eight Edition, Pearson Education, 2007.
- [7] J.R. Jiao, Y. Zhang, M. Helander, "A Kansei mining system for affective design", *Expert Systems with Applications*, 30, (2006), pp. 658-673.
- [8] A. Berson, S. Smith, K. Thearling, *Building Data Mining Applications for CRM*, McGraw-Hill, 2000.
- [9] Y.L. Chen, C.L. Hsu, S.C. Chou, "Constructing a Multi Valued and Multi Labeled Decision Tree", *Expert Systems with Applications*, 25, (2003), pp. 199-209.
- [10] D. Rastogi, "Information Innovation and Data Mining".
- [11] H. Shaikh, K.W. Habib, J. Ibrahim, "The Impact of Social Media on Consultancy", *Sindh Univ. Res. Jour. (Sci. Ser.)* Vol.46 (3):2014.
- [12] S. Pettypiece, J. Robertson, "Hospitals are Mining Patient's Credit Card Data to Predict Who Will Get Sick", *Bloomberg Business*, July, 2014. Available: <http://www.bloomberg.com/bw/articles/2014-07-03/hospitals-are-mining-patients-credit-card-data-to-predict-who-will-get-sick>. [Accessed: April 14, 2015].
- [13] H. Weisbaum, "Data Mining Is Now Used To Set Insurance Rates; Critics Cry Foul". *CNBC Consumer*, April, 2014. Available: <http://www.cnbc.com/id/101586404>. [Accessed: April 14, 2015].

AUTHORS

First Author – Mehran Qadri, Master of Information Technology, Faculty of Information and Communication Technology, International Islamic University Malaysia.

Second Author – Zubair Ahmad, Master of Information Technology, Faculty of Information and Communication Technology, International Islamic University Malaysia.

Third Author – Jamaludin Ibrahim, Master of Operations Research, Senior Academic Fellow, Faculty of Information and Communication Technology, International Islamic University Malaysia.

Correspondence Author – Mehran Qadri, qmehran2@live.utm.my.

Economic Wealth Index: A tool to study the Economic Health of Districts of selected States in India

Anjum Ara Ahmad

Department of Mathematics & Statistics, Rizvi College of Arts, Science & Commerce, Mumbai

Abstract- The Economic Wealth Index (EWI) is created using the principal component analysis (PCA) method on the amenities data of Census 2001. The first principal component is used to create the index. An attempt is made in this research to the economic health of the districts of some selected states like Kerala, Maharashtra and Bihar/Jharkhand. The selected states represent almost all the regions of India i.e. Kerala from South, Maharashtra from West and Bihar/Jharkhand from North-East. The districts of the selected States are ranked based on the values of the index. When the researcher compared the district level value of this index with the Human Development index value, the researcher found that the two values are highly correlated with each other for the State of Maharashtra. Hence this method can be used to study the economic conditions of the districts of the States and can be used as an alternative to HDI values as district level HDI values are not available for all states.

Index Terms- Economic Wealth Index, Principal Component Index, Human Development Index, India

I. INTRODUCTION

An attempt is made in this research to the economic health of the districts of some selected states like Kerala, Maharashtra and Bihar/Jharkhand. The selected states represent almost all the regions of India i.e. Kerala from South, Maharashtra from West and Bihar/Jharkhand from North-East. Also as far as development is considered Kerala and Maharashtra is one of the most developed states while Bihar and Jharkhand are one of the less-developed states. The Economic Wealth Index (EWI) is created using the principal component analysis (PCA) method on the amenities data of Census 2001.

II. OBJECTIVE OF THE STUDY

- i. To create the economic wealth index using Principal Component Analysis
- ii. To classify EWI values into categories.
- iii. To rank the districts of the selected States
- iv. To compare the EWI values of the districts of Maharashtra with Human Development Index

III. RESEARCH METHODOLOGY

Principal Component Analysis Method (PCA) is used to construct the Economic Well-Being Index (EWI) based on the amenities data, condition of houses and presence of various basic

facilities like drinking water, electricity and toilet given by Census. In this study the first principal component is used to create the index. The data of nineteen variables are taken from the Census Amenities tables of Census 2001 data. The PCA is run in the pooled data of the Selected States. It was found in the study that index created with help of only first component behaved the best when compared with Human Development Index.

Further the districts are ranked on the basis of the value of this index. The EWI index calculated at the state level is compared to the HDI value for checking the robustness of the index.

3.1 Principal Components Analysis

PCA is a multivariate statistical technique used to reduce the number of variables in a data set into a smaller number of 'dimensions'. In mathematical terms, from an initial set of n correlated variables, PCA creates uncorrelated indices or components, where each component is a linear weighted combination of the initial variables.

Before applying the PCA following tests are necessary:

- a) **Kaiser-Meyer-Olkin Measure of Sampling Adequacy:** This measure varies between 0 and 1, and values closer to 1 are better. A value of 0.5 is a suggested minimum.
- b) **Bartlett's Test of Sphericity:** This tests the null hypothesis stating that the correlation matrix is an identity matrix. An identity matrix is one in which all of the diagonal elements are 1 and all off diagonal elements are 0. This null hypothesis should be rejected.

Taken together, these tests provide a minimum standard which should be passed before principal components analysis (or factor analysis) should be conducted.

3.2 Composite Index: The indexing of districts using a set of variables has multiple uses. It helps in assessing current level of development, monitor the trends and identify target areas and groups requiring special attention not only by the country but in each state and district as well. The composite index is computed after standardizing the variables and by fixing the upper and lower limit.

3.2.1 Standardization of Indicators : The indicators may be grouped into positive and negative indicators. For example coverage of complete immunization is a positive indicator while proportion of births of order three and above is a negative indicator. In computing composite indices the

researcher has to make them uniform and therefore there is a need of standardizing each indicator.

For positive indicators, composite index is usually computed as

$$100 * (V_i - V_{min}) / (V_{max} - V_{min})$$

Here V_i is Actual Value in the series, V_{min} is lowest value observed in the series, V_{max} is highest value observed in the series. This simply states that the district with a lowest value will get a score of 0 and district with a highest value will get a score of 100.

In case variables affect negatively, composite index is computed as $100 * (V_{max} - V_i) / (V_{max} - V_{min})$.

3.3 Selection of Variables: The data of amenities which are available district wise in Census (2001) are used for the construction of the Economic Wealth Index. Percentages of households possessing these amenities are calculated from Census (2001) data. To estimate the economic wealth index, principal component analysis based on the first principal component is used.

Following Nineteen variables have been selected for developing the index from the amenities district wise data of the four selected states.

- 1) Percentage of households having Good condition houses (Gd_con_houses).
- 2) Percentage of households having Permanent houses (Per_perm).
- 3) Percentage of households having Separate kitchen (Per_sepkit).
- 4) Percentage of households having LPG connection (Per_LPG).
- 5) Percentage of households having Electricity (Per_elec).
- 6) Percentage of households having Water within Premises (Per_water).
- 7) Percentage of households having Bathrooms (Per_of_bath).
- 8) Percentage of households having Drainage (Per_of_drain).
- 9) Percentage of households having Toilets (Per_toilet).
- 10) Percentage of households having Cement or Mosaic Flooring (Per_cemmosaicfloor).
- 11) Percentage of households having Concrete Roof (Per_concreteroof).
- 12) Percentage of households having Brick, Stone and Concrete Walls (Per_brstconcretewall).
- 13) Percentage of households having Bank accounts (Per_bank).
- 14) Percentage of households having Radio (Per_radio).
- 15) Percentage of households having Television (Per_TV).
- 16) Percentage of households having Telephone (Per_telephone).
- 17) Percentage of households having Bicycles (Per_bicycles).

18) Percentage of households having Scooter (Per_scootermotor).

19) Percentage of households having Car or Jeep (Per_carjeep).

By definition the first principal component variable across households or individuals has a mean of zero and a variance of X, which corresponds to the largest Eigenvalue of the correlation matrix of X. The first principal component yields a wealth index that assigns a larger weight to assets that vary the most across households so that an asset found in all households is given a weight of zero (McKenzie, 2005). The first principal component can take positive as well as negative values.

The SPSS factor analysis procedure is used in this study. This procedure first standardizes the indicator variables (calculating Z scores); then the factor coefficient scores (factor loadings) are calculated; and finally, for each district, the indicator values are multiplied by the loadings and summed to produce the Economic Wealth Index (EWI) value for each district. In this process, only the first factor produced is used to represent the index. The resulting sum is itself a standardized score with a mean of zero and a standard deviation of one.

3.4 Economic Wealth Index Code: The values of Economic Wealth Index (EWI) are divided into three quartiles Q_1 , Q_2 and Q_3 . The District with EWI values less than Q_1 is given code 0. The district with EWI values between Q_1 and Q_2 is given code 1, district with EWI values between Q_2 and Q_3 is given code 2 and district with EWI values above Q_3 is given code 3. Thus the districts are classified as district with low economic condition (Code 0), moderate economic condition (Code 1), good economic condition (Code 2) and excellent economic condition (Code 3).

3.5 Composite Economic Wealth Index (CEWI)

Since the EWI index takes positive as well as negative values, the Composite EWI index is computed using the formula

$$\text{Composite EWI} = \frac{(\text{EWI Value} - \text{Minimum EWI Value}) * 100}{\text{Max EWI Value} - \text{Min EWI Value}}$$

IV. ANALYSIS OF DATA

The data was analyzed the results are as follows

4.1. KMO and Bartlett's Test for EWI: The KMO Measure of Sampling Adequacy is 0.845 (Table 1) which is a very good value. Also the Bartlett's Test of Sphericity is significant. Thus it is found in the study that the data is fit for principal component analysis.

Table 1: KMO and Bartlett's Test for EWI

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.845
Bartlett's Test of Sphericity	Approx. Chi-Square	3643.754
	Df	171
	Sig.	.000

Source: Derived with the help of SPSS

4.2. Total Variance Explained by the Components

The principal components are extracted using SPSS. The first four Components had Eigen values more than 1 (Refer Table 2). The first four components explained 87.1 percent of variance in the data.

To construct the EWI the researcher decided to use the first principal component only. The first component itself is able to explain 63.969 percent of variance in the data.

Table 2: Total Variance Explained by the Components

Comp	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	percent of Variance	Cumulative percent	Total	percent of Variance	Cumulative percent
1	12.154	63.969	63.969	12.154	63.969	63.969
2	1.761	9.268	73.238			
3	1.555	8.183	81.420			
4	1.079	5.679	87.100			
5	.661	3.478	90.578			
6	.473	2.487	93.065			
7	.378	1.988	95.054			
8	.285	1.502	96.556			
9	.171	.902	97.458			
10	.134	.704	98.162			
11	.099	.523	98.685			
12	.070	.370	99.056			
13	.055	.291	99.347			
14	.044	.234	99.581			
15	.034	.178	99.759			
16	.018	.097	99.855			
17	.014	.073	99.928			
18	.010	.055	99.982			
19	.003	.018	100.000			

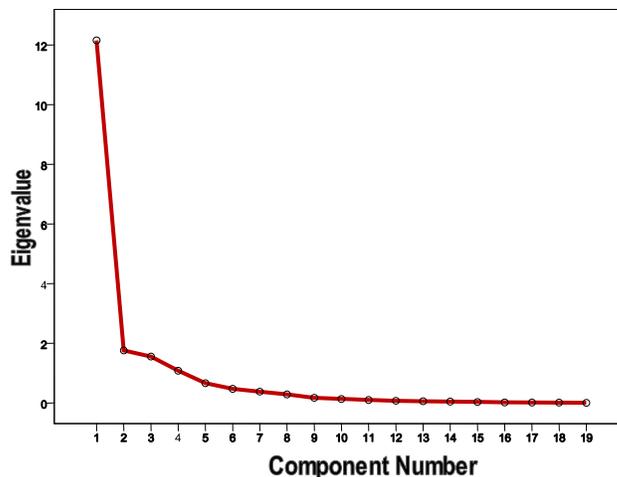
Extraction Method: Principal Component Analysis.

Source: Derived with the help of SPSS

4.3. Scree Plot of the Components

The Scree plot (Figure 1) helps one to determine the optimal number of components. The Eigen value of each component in the initial solution is plotted. Generally the components on the

steep slope are extracted. The components on the shallow slopes contribute little to the solutions. The figure clearly points that in the Scree plot the largest variation is due to the first principal component only.



Source: Drawn with the help of SPSS

Figure 1: Scree Plot for EWI

4.4. First Principal Component Matrix: The first Principal Component is given below (Table 3). It is observed in Table 3 that the highest variance in the data is due to percentage of

cement and mosaic floor (0.938) followed by percentage of telephone (0.928) and percentage of television (0.927).

Table 3: First Principal Component Matrix

Component Matrix ^a	Component 1
Gd_con_houses	.892
Per_perm	.820
Per_sepkit	.678
Per_LPG	.861
Per_elec	.903
Per_water	.780
Per_of_bath	.891
Per_of_drain	.584
Per_toilet	.844
Per_cemmosiacfloor	.938
Per_concreteroof	.587
Per_brstconcretewall	.802
Per_bank	.898
Per_radio	.786
Per_TV	.927
Per_telephone	.928
Per_bicycles	-.582
Per_Scootermotor	.693
Per_carjeep	.917
Extraction Method: Principal Component Analysis.	
a. 1 component extracted.	

Source: Derived with the help of SPSS

4.5. Component Score Coefficient Matrix of the EWI factors

The Component (or Factor) Score Coefficient Matrix is given below in Table 4. As observed in the initial communalities, in the Component (or Factor) Score Coefficient Matrix also it is

observed that the highest score is of Percentage of Cement and Mosaic Flooring (0.077) followed by Percentage of Telephone (0.076) and Percentage of Television (0.076).

Table 4: Component Score Coefficient Matrix

	Component 1
Gd_con_houses	.073
Per_perm	.068
Per_sepkit	.056
Per_LPG	.071
Per_elec	.074
Per_water	.064
Per_of_bath	.073
Per_of_drain	.023
Per_toilet	.069
Per_cemmosiacfloor	.077
Per_concrete roof	.048
Per_brstconcretewall	.066
Per_bank	.074
Per_radio	.065
Per_TV	.076
Per_telephone	.076
Per_bicycles	-.031
Per_Scootermotor	.057
Per_carjeep	.075
Extraction Method: Principal Component Analysis.	

Source: Derived with the help of SPSS

4.6. Descriptive Statistics of EWI: The descriptive statistics of the EWI is given below (Table 56). The mean value is 0 and the standard deviation and the variance is 1. The maximum

value is 2.65 and the minimum value is -1.32. Range which is defined as the difference between the maximum and minimum value is 3.97.

Table 5: Descriptive Statistics of EWI

Statistics		
EWI		
N	Valid	108
	Missing	0
Mean		0
Median		-.2650
Mode		-.57
Std. Deviation		1
Variance		1
Range		3.97
Minimum		-1.32
Maximum		2.65
Percentiles	25	-.8212
	50	-.2653
	75	.8278

Source: Derived with the help of SPSS

4.7. Ranking the Economic Wealth Index

Using the Composite index formula, the Composite Economic Wealth Index (CEWI) is calculated. The EWI value is ranked. In the ranked EWI values, Mumbai (with value 2.65) from Maharashtra gets the highest rank and Pakaur (with value -1.32) from Jharkhand is the least rank district. The next four rankings go to the district Ernakulum, Mumbai (Suburban), Pune and Thane. Out of the top five, four are from the state of Maharashtra. The last five districts in rankings are Pakaur, Garhwa, Gumla, Sahibganj and Araria. Out of the five worst ranked districts in the pooled data, 4 are from Jharkhand and one from Bihar. The calculated EWI, Rank of EWI, CEWI and Code of EWI for all the districts in the four States are given in the Appendix 1.

4.8 Economic Wealth Code

In order to classify the district into low, moderate, good and excellent economic conditions, EWI has been coded as 0, 1, 2 and 3 respectively. The three quartiles of the data are calculated.

The three quartiles Q_1 , Q_2 and Q_3 are -0.8212, -0.2653 and 0.8278 respectively. These values are given in the Table 6 as the 25th, 50th and 75th Percentile.

4.9 Classification of districts according to EWI Code

The districts in each States are classified into different EWI Code. It is observed in Table 6 that in Bihar there are 16 districts with EWI Code 0, 19 districts with EWI Code 1 and only 3 districts namely Patna, Hazaribag and Rohtas with EWI code 2. In Jharkhand there are 10 districts with EWI Code 0, 4 districts with code 1 and 5 districts with code 2. In both Bihar and Jharkhand there is no district with code 3 i.e. excellent EWI values. In the State of Maharashtra there is not a single district with EWI code 0 but 5 districts with EWI code 1, 20 districts with EWI code 2 and 11 districts with EWI code 3. In Kerala, districts have the best EWI values, all the districts of Kerala has EWI Code 3 i.e. excellent EWI.

Table 6: EWI Classification among the States

EWICODE * State code Cross tabulation							
Count							
			State code				Total
			Bihar	Jharkhand	Maharashtra	Kerala	
EWICODE	0	Low	16	10	0	0	26
	1	Moderate	19	4	5	0	28
	2	Good	3	5	20	0	28
	3	Excellent	0	0	11	15	26
Total			38	19	36	15	108

Source: Derived with the help of SPSS

4.10 Comparison of EWI values with HDI values

To compare the robustness of EWI created with principal component method, the EWI values are calculated for all the districts of Maharashtra by the same method as in the pooled data. This time the researcher used only Maharashtra State amenities data from Census 2001.

The EWI values are then compared with the district level Human Development Index (HDI) values given by the Human Development Report Maharashtra (2002). The researcher has ranked the EWI and the HDI values for all the districts of Maharashtra and calculated the Component EWI (CEWI) and Composite HDI.

The Table 7 gives the EWI and the HDI values of the districts in Maharashtra. The Coefficient of Correlation between EWI and HDI values is found to be very good (0.876). Also the difference between the rankings is less than 10 for 29 districts and less than 5 for 23 districts. Hence it indicates that, one can use EWI to measure the economic health of a place and this index is very compatible to HDI index. Also it can be used as an alternative measure to HDI as district level HDI values are not given for all States.

Table 7: EWI and HDI values of the districts in Maharashtra

Sr. No	State/District	EWI	CEWI	RANK EWI	HDI	Comp HDI	RANK HDI	Diff. in Ranking of EWI and HDI
	MAHARASHTRA	0.54	48.14	7	0.58	47.50	12	-5
1	Nandurbar	-1.22	3.58	33	0.2	0.00	34	-1
2	Dhule	-0.36	25.35	19	0.36	20.00	30	-11
3	Jalgaon	0.14	38.04	12	0.49	36.25	15	-3
4	Buldana	-0.62	18.71	25	0.39	23.75	28	-3
5	Akola	0.07	36.16	13	0.42	27.50	24	-11
6	Ishim	-0.9	11.7	31	0.48	35.00	17	14
7	Amravati	-0.03	33.65	15	0.81	76.34	4	11
8	Wardha	0.02	34.81	14	0.49	36.25	15	-1
9	Nagpur	1.37	69.05	5	0.71	63.75	6	-1
10	Bhandara	-0.61	19.02	24	0.46	32.50	18	6
11	Gondiya	-1.22	3.49	34	0.46	32.50	18	16
12	Gadchiroli	-1.36	0	35	0.2	0.00	34	1
13	Chandrapur	-0.35	25.53	18	0.41	26.25	27	-9
14	Yavatmal	-0.88	12.2	30	0.21	1.25	33	-3
15	Nanded	-0.76	15.06	27	0.36	20.00	30	-3
16	Hingoli	-1.08	6.92	32	0.42	27.50	24	8
17	Parbhani	-0.66	17.69	26	0.42	27.50	24	2
18	Jalna	-0.81	13.79	28	0.26	7.50	32	-4
19	Aurangabad	0.34	43.06	11	0.56	45.00	13	-2
20	Nashik	0.46	45.98	8	0.51	38.75	14	-6
21	Thane	1.86	81.64	4	0.83	78.75	3	1
22	Mumbai (Sub)	2.33	93.36	2	1	100.00	1	1
23	Mumbai	2.59	100	1	1	100.00	1	0
24	Raigarh	0.43	45.2	10	0.71	63.75	6	4
25	Pune	1.87	81.69	3	0.76	70.00	5	-2
26	Ahmadnagar	-0.04	33.44	16	0.57	46.25	12	4
27	Bid	-0.86	12.63	29	0.44	30.00	23	6
28	Latur	-0.41	24.02	20	0.46	32.50	18	2
29	Osmanabad	-0.57	20.08	23	0.38	22.50	29	-6
30	Solapur	-0.2	29.45	17	0.46	32.50	18	-1
31	Satara	0.44	45.44	9	0.59	48.75	11	-2
32	Ratnagiri	-0.52	21.27	22	0.46	32.50	18	4
33	Sindhudurg	-0.44	23.19	21	0.64	55.00	9	12
34	Kolhapur	0.89	57.03	6	0.64	55.00	9	-3
35	Sangli	0.54	48.12	7	0.68	60.00	8	-1

Source: 1) EWI values derived with the help of SPSS, CEWI and Rankings calculated using formulas
2) HDI values taken from Human Development Report Maharashtra, 2002

V. CONCLUSIONS

The Economic Wealth Index (EWI) values are ranked in descending order, the first five rankings went to the district Mumbai, Ernakulam, Mumbai (Suburban), Pune and Thane. Out of the top five, four are from the state of Maharashtra. And the last five districts in rankings are Pakaur, Garhwa, Gumla, Sahibganj and Araria. Out of the five worst ranked districts in the pooled data, four are from Jharkhand and one from Bihar. In the State of Maharashtra there is no district with low EWI but 5 districts with moderate EWI, 20 districts with good EWI and 11 districts with excellent EWI. All the districts of Kerala have excellent EWI.

The results point out that correlation between Composite Economic Wealth Index (CEWI) and mean number of births is significant only in the pooled data, the State of Maharashtra and Jharkhand. When the correlation between CEWI and IMR as well as FWPR is studied, it is found to be significant in the pooled data and in all the selected States except Kerala.

VI. SUGGESTIONS

- The study pointed out that Bihar and Jharkhand are the States whose districts have low Economic Wealth Index values. Hence using these indices districts which are not that good in these categories can be traced and development plans can be chalked out to improve the economic conditions of these districts.
- This method can be used to study the economic and wealth index of other States also.

VII. LIMITATIONS

Census 2001 data has been used for the study as Census 2011 data for amenities was not available at the time of study.

Appendix 1: EWI and CEWI values in Pooled data

State/District Code	State/District	EWI	CEWI	Rank EWI	EWI CODE
10	STATE-BIHAR	-0.69	15.79	76	1
1	Pashchim Champaran	-0.99	8.24	89	0
2	Purba Champaran	-0.83	12.21	84	0
3	Sheohar	-1.12	5.05	102	0
4	Sitamarhi	-1.00	7.94	91	0
5	Madhubani	-0.89	10.91	86	0
6	Supaul	-1.06	6.53	95	0
7	Araria	-1.14	4.65	104	0
8	Kishanganj	-1.10	5.52	99	0
9	Purnia	-1.07	6.22	97	0
10	Katihar	-1.02	7.64	92	0
11	Madhepura	-1.05	6.68	94	0
12	Saharsa	-0.96	9.09	87	0
13	Darbhanga	-0.77	13.96	80	1
14	Muzaffarpur	-0.71	15.29	77	1
15	Gopalganj	-0.60	18.03	70	1
16	Siwan	-0.34	24.65	57	1
17	Saran	-0.40	23.08	58	1
18	Vaishali	-0.74	14.68	79	1
19	Samastipur	-0.83	12.32	83	0
20	Begusarai	-0.60	18.01	71	1
21	Khagaria	-0.98	8.63	88	0
22	Bhagalpur	-0.51	20.32	64	1
23	Banka	-1.11	5.37	100	0
24	Munger	-0.25	26.98	54	2
25	Lakhisarai	-0.59	18.45	69	1
26	Sheikhpura	-0.64	17.15	73	1
27	Nalanda	-0.57	18.79	67	1
28	Patna	0.68	50.39	29	2
29	Bhojpur	-0.31	25.39	56	1
30	Buxar	-0.48	21.13	63	1
31	Kaimur (Bhabua)	-0.73	14.85	78	1
32	Rohtas	-0.22	27.66	51	2
33	Jehanabad	-0.57	18.77	68	1

34	Aurangabad	-0.57	18.88	66	1
35	Gaya	-0.69	15.88	75	1
36	Nawada	-0.78	13.55	81	1
37	Jamui	-1.07	6.22	96	0
20	STATE-JHARKHAND	-0.42	22.56	60	1
1	Garhwa	-1.30	0.45	107	0
2	Palamu	-1.04	7.16	93	0
3	Chatra	-1.12	4.93	103	0
4	Hazaribag	-0.05	32.02	44	2
5	Kodarma	-0.46	21.73	61	1
6	Giridih	-0.82	12.64	82	1
7	Deoghar	-0.68	16.05	74	1
8	Godda	-1.09	5.84	98	0
9	Sahibganj	-1.14	4.55	105	0
10	Pakaur	-1.32	0.00	108	0
11	Dumka	-1.11	5.21	101	0
12	Dhanbad	0.67	50.26	30	2
13	Bokaro	0.67	50.15	31	2
14	Ranchi	-0.08	31.34	45	2
15	Lohardaga	-1.00	7.97	90	0
16	Gumla	-1.16	4.13	106	0
17	Pashchimi Singhbhum	-0.85	11.73	85	0
18	Purbi Singhbhum	0.82	53.97	27	2
27	STATE-MAHARASHTRA	0.91	56.29	22	3
1	Nandurbar	-0.47	21.34	62	1
2	Dhule	0.17	37.46	39	2
3	Jalgaon	0.54	46.75	32	2
4	Buldana	-0.09	31.11	46	2
5	Akola	0.43	44.09	34	2
6	Washim	-0.28	26.16	55	1
7	Amravati	0.33	41.64	36	2
8	Wardha	0.39	43.06	35	2
9	Nagpur	1.47	70.25	13	3
10	Bhandara	-0.09	30.99	47	2
11	Gondiya	-0.54	19.54	65	1
12	Gadchiroli	-0.62	17.62	72	1
13	Chandrapur	0.16	37.22	40	2
14	Yavatmal	-0.24	27.08	53	2
15	Nanded	-0.17	28.93	49	2
16	Hingoli	-0.42	22.77	59	1
17	Parbhani	-0.13	29.90	48	2
18	Jalna	-0.22	27.74	50	2
19	Aurangabad	0.71	51.07	28	2
20	Nashik	0.89	55.72	23	3
21	Thane	1.96	82.70	5	3
22	Mumbai (Sub)	2.44	94.75	3	3
23	Mumbai	2.65	100.00	1	3
24	Raigarh	0.92	56.42	20	3
25	Pune	2.04	84.72	4	3
26	Ahmadnagar	0.48	45.31	33	2
27	Bid	-0.24	27.17	52	2
28	Latur	0.15	37.03	41	2
29	Osmanabad	-0.01	33.02	43	2
30	Solapur	0.30	40.83	37	2
31	Satara	0.88	55.36	24	3
32	Ratnagiri	0.13	36.58	42	2

33	Sindhudurg	0.17	37.53	38	2
34	Kolhapur	1.18	63.00	18	3
35	Sangli	0.92	56.40	21	3
32	STATE-KERALA	1.54	72.16	10	3
1	Kasaragod	1.25	64.68	16	3
2	Kannur	1.59	73.30	9	3
3	Wayanad	0.86	54.91	25	3
4	Kozhikode	1.51	71.43	11	3
5	Malappuram	1.24	64.61	17	3
6	Palakkad	0.98	57.89	19	3
7	Thrissur	1.86	80.21	6	3
8	Ernakulam	2.55	97.63	2	3
9	Idukki	0.85	54.57	26	3
10	Kottayam	1.85	79.81	7	3
11	Alappuzha	1.47	70.27	12	3
12	Pathanamthitta	1.82	79.21	8	3
13	Kollam	1.36	67.64	15	3
14	Thiruvananthapuram	1.39	68.35	14	3

Source: EWI values derived with the help of SPSS. CEWI and Rankings calculated using formulas

REFERENCES

- [1] Registrar General of India, (2001); Census of India, Ministry of Home Affairs, New Delhi.
- [2] McKenzie, David J. (2005); Measuring Inequality with Asset Indicators, Journal of Population Economics 18, 2: pp. 229-60.

AUTHOR

First Author – Dr (Mrs.) Anjum Ara M K Ahmad
Vice- Principal & Associate Professor, Department of
Mathematics & Statistics, Rizvi College of Arts, Science &
Commerce, Affiliated to University of Mumbai, Mumbai,
anjumahmed8@gmail.com, +919819825929

Mental lexicon: A conceptual framework

Othman Aref Al-Dala'ien*, Badri Abdulhakim D.M. Mudhsh **, Ayman Hamid Al-Takhayinh **

Department of Linguistics
Aligarh Muslim University AMU
Aligarh, India

Abstract- The paper discussed the concept of mental lexicon or mental dictionary and some other studies related to the area of mental lexicon. How lexical items are accessed, acquired and ordered in the mind is a controversial area for both linguists and psychologists. The mental lexicon is a complicated structure organized in many ways. This paper discusses the notion of mental lexicon and what are the similarities and contrasts between mental lexicon and physical dictionary, methods and ways used for inquiry and the role of mental lexicon in case of learning and acquisition of language as well as an overview on the language and memory. The paper covers research findings in this area.

The study has conducted on the qualitative method that based up on observations and collecting material besides the observations mainly taken from theoretical observations of scholars and researchers, moreover collected materials also have been taken from collecting information that was found on published papers, books etc.

The conclusion highlights the significance of the mental lexicon and how it touches all the aspects of psycholinguistics and it also confirms that mental lexicon is complex and flexible much more than any physical dictionary, in order to cover the research findings in this area some issue that are related to mental lexicon in many ways are discussed.

Index Terms- dictionary, mental lexicon, mind, language learning, language acquisition

I. INTRODUCTION

The term mental lexicon which was introduced by R.C Oldfield in "things, words and the brain" has become an increasingly salient aspect of psycholinguistic research. In psycholinguistics, mental lexicon is a person's internalized knowledge of the properties of words.

According to Jean Aitchison in his book *Words in the mind* "unlike book dictionaries, mental dictionaries cannot be organized solely on the basis of sounds or spelling. Meaning must be taken into consideration as well, since humans fairly often confuse words with similar meanings, as in 'Please hand me the tin-opener' when the speaker wants to crack a nut, so must have meant 'nut-crackers.'" (Jean Aitchison, 2003)

Marcus Taft has cited an example explaining the mental lexicon:

"Even with hard yakka, you've got Buckley's of understanding this dinkum English sentence, unless you're an Aussie".

"An Australian has no difficulty understanding the above sentence, while other English speakers might struggle. The words 'yakka,' 'Buckley's,' and 'dinkum' are in the vocabulary of most

Australians, that is, they are stored as entries in the **mental lexicon**, and therefore an Australian has access to the meanings of these words and can consequently comprehend the sentence. If one possessed no mental lexicon, communication through language would be precluded." (Marcus Taft, 1999).

II. REVIEW OF LITERATURE

In the early Generative Grammar (Chomsky, 1965) the idea about the lexicon was just that it is a list of words on which syntax, the central module, operated. But recently, the study of the lexicon has been given more importance and it has received a reinforcement from the researches of cognitive psycholinguists (e.g. Taft and Foster, 1975; Henderson, 1985), neuropsychologists (e.g. Caramazza, 1997), specialists of reading such as (Rumelhart, 1977; Besner, Waller and Mackinnon, 1985), and cognitive scientists (e.g. McClelland and Rumelhart, 1981; Marcus, 2001), it's to mention the central disciplines.

The mental lexicon has become a common aspect and has attracted a large number of researchers to investigate. The mental lexicon is known as a mental dictionary which contains information about a word's pronunciation, meaning, syntactic attributes, and so on, (Jackendoff, R.S, 2002). In linguistics and psycholinguistics Mental Lexicon used to refer to individual speaker's lexical or word, representations.

The mental lexicon is not a collection of words, it also deals with how those words are stored, activated, processed and retrieved by a speaker whenever he/she wants. An individual's mental lexicon is not perpetual; it is always developing and growing as new words are learned. Many theories about the issue of how mental lexicon occurs were argued.

Nativist Theory, a theory hypothesized by Noam Chomsky who used the idea that language is an innate, it's to say that human beings are born with a set of rules in their heads about language which termed as UNIVERSAL GRAMMAR. According to Chomsky the ability to learn grammar is hard-wired into the brain. In this theory he proposed that if we are brought up under normal conditions, then we will always be able to develop language with a certain property X (e.g. differentiating function words from lexical words or differentiating nouns from verbs) in this case property X is considered as a property of universal grammar.

Dual – Coding theory, a theory of cognition by Allan Pavio, his idea is about the role of the formation which is presented by mental images in learning, Pavio proposed that the formation of mental images helps in learning (Reed, 2010), according to Pavio there are two ways a subject could expand on learned material which are: visual imagery and verbal associations.

Dual-Coding theory assumes that verbal and visual information is used to represent information (Sternbuerg, 2003).

As well as the Semantic Network theory by Charles S. Pierce (1909), the theory of semantic network proposes a graphical nodes and edges that he called 'the logic of future' (Russell, Stuart J.; Norvig, Peter, 2010). A semantic network is a frame network that represents semantic relations between concepts. It is used as a kind of knowledge representation and it is a directed or undirected nodes consisting of vertices that represent concepts and edges (John F.Sowa, 1987) this network can be used when a person knowledge that is best understood as a set of concepts which are related to each other. Mostly semantic networks are cognitively based.

The theory of semantic network is a hypothetical mental process which works when one of nodes in the network is triggered, and suggests three methods namely: frequency effects, priming effects and neighborhood effects.

- Frequency effects, propose that words which are frequent in a one's language can be recognized faster than those that are infrequent (Foster, K. I, 1976).
- Priming that is termed to use in lexical decision tasks; it is to decrease reaction times of related words, the ability to have interchangeable words aid in the reaction times of others (Traxler, matthew ;2011).
- Neighborhood effects refer to the triggering or the activation process of similar neighbors of a target word, those neighbors known as items which are confusable with the target word because of their overlapping features (Andrew, Sally; 1989).

According to (Elman, J. L. 2004), a key part of knowing language is knowing the words of that language. This knowledge is ordinarily thought to live in the mental lexicon, a sort of word reference that contains data in regards to a word's pronunciation, meaning, syntactic qualities, and so on. In this perspective, words are seen as boosts that work specifically on mental states. The phonological, syntactic also, semantic properties of a word are uncovered by the impacts it has on those states. The perspective propelled here is comparative in a few regards to a few past propositions. The thought of 'direct perception' is itself not new. There is a nearby partiality with MacDonald and Christiansen's proposition in regards to working memory. The essential recommendation of his proposition is to regard words as stimuli, whose "signifying" lies in the causal impacts they have on mental states. Then again, to summarize Dave Rumelhart – words don't have meaning; they are signals or cues to meaning.

Some psycholinguists and linguists don't believe in the existence of the mental lexicon and it is considered as a controversial concept. One theory about the mental lexicon suggests that it is "a collection of highly complex neural circuits" (Foster, K. I, 1976), another proposes that mental lexicon organize our knowledge about words "in some sort of dictionary" (Foster, K. I, 1976)

III. MENTAL LEXICON VS. PHYSICAL DICTIONARIES

As the Mental lexicon includes similar properties or information to those found in a dictionary, it could even be contended whether they are very nearly the same. So as to demonstrate or

refute this proposal, it is important to quickly take a gander at their similarities and contrasts.

Truly, the implications of words are put away in both, as socio-cultural data about use, and so on. Both the dictionary and the mental lexicon empower the speaker to recall information about the use of a vocabulary item. Lexicons generally can contain the grammatical forms a unit can take. That sort of data is furthermore kept in the mind, despite the fact that it may not be found as obviously organized as in a physical lexicon. The item "scarf" is labeled in the Oxford advanced Dictionary as noun and verb while a normal learner of the English language is most likely not ready to utilize this item in both forms when it is at first learnt. The way that it can be utilized all the more generally might be found later when the item is "re-learned" in another setting. Information, along these lines, can likewise be given on the diverse types of things yet they are more available in a dictionary than they are in the mental lexicon.

Another highlight which the mental lexicon and dictionaries have in like manner is the register of a vocabulary item. A dictionary is liable to list the word "stuff" as casual or colloquial. A speaker of the English language, then again, would know when to utilize that item effectively on the grounds that items in the mental lexicon dependably accompany their connoted meaning. Connotations are, obviously, recorded in both the mental lexicon and a physical dictionary. Hence, the mental lexicon can even be more exact than a dictionary on the grounds that dictionaries generally don't list the greatest number of connotations as the Mental Dictionary can store. Other than the similarities expressed above, there are likewise contrasts between the Mental Vocabulary and lexicons (Aitchison, 2003).

IV. NETWORK MODEL

Research findings about the way lexical items are stored and memory proposes that those lexical items are related to each other by sight as well as by meaning, sound and form in a network of associations. Thus they can be stored and remembered by means of these associations that can be of many different types and ways (Nattinger, 1988).

V. LEXICAL DECISION TASK: AN OVERVIEW

Mental lexicon is sometimes called mental dictionary as mentioned above, but human mental dictionaries are organized with links between semantically and phonologically related words or lexical items (Jean Aitchison, 2003), Unlike the human mental dictionaries which seem to be organized alphabetically. Another difference is there between mental and book dictionaries that the mental lexicon always updates itself with new lexical items and word meanings while book dictionaries contain a fix number of words and word meanings. In research there are continuous efforts to identify the proper way of how words are linked and accessed. A known method in this field to analyze those links is by the help of a *Lexical decision task* (Contemporary linguistic analysis,2008), in this task participants required to respond as accurately and quickly as

possible to a string of letters presented on a computer display and they are required to tell if the string is a related word or non-word(Altman, Gerry;1999), then times of reaction indicate that these words are more 'Active' in participants minds after related words have been presented, this method enables the researchers to identify whether a set of related lexical items are stored closely in the mental dictionary, if yes then they will be able to analyze with what related counterparts words are stored and what can activate them(Altman,Gerry;1999).

VI. LANGUAGE ACQUISITION AND LANGUAGE LEARNING

According to Channel (Carter and Mc Carthy, 1988), second language is considered as acquired by a learner when the meaning of a word can be understood rather than used, and it can be used naturally in a proper situation. Learning as a process leads to the acquisition as a final result.

It is generally supposed that receptive words are a learner comes across in listening and reading, while productive words those are used in speaking and writing. According to the previous assumption of acquisition of vocabulary, productive acquisition is preceded by receptive acquisition. Researchers are trying to find out how acquisition takes place from the stage of reception to the stage of production, but several theorists proposed that words are not a part of productive capacity, but they remain a part of receptive capacity. According to Fay and Carter (Carter, 1988) the direction of mapping during comprehension is sound to meaning and meaning to sound during production, this kind of mapping led to the perception that there could be two listing of words that are represented and organized in a way enabling easy recall and retrieval.

Another important issue here is first language acquisition, vocabulary growth is one of the concerns of research on the development of the mental lexicon. Researches assume that the words acquired in the stage of language development are mostly nouns or noun-like, we can observe the similarities in early words among children {e.g. Baba, Mama} (Contemporary linguistic analysis, 2008). Other researches assume that words need a type of acknowledgement before they are effectively stored in the mental dictionary of children.

VII. ON THE LANGUAGE AND MEMORY

When a subject knows a word it means (x) that the word is retained in a particular way that enables the subject to comprehend and recognize it during reading or listening and to use it while writing or speaking (and this is the process of bringing it out of storage), when required. Processes, production and understanding or comprehension of language are involving a person's memory that contains lexicons (in case of the speaker knows two languages), that is known as the human word store or human mental lexicon.

The distinction between long term memory (LTM) and short term memory (STM) is clear. The long term memory LTM that contains the word store or the mental lexicon, An individual has an account of words are ordered and represented in a manner enabling easy retrieval or recall, that reveals a close connection between memory and language.

VIII. CONCLUSION

As the current work is a conceptual frame work about mental lexicon, it discusses several issues that are related to the mental lexicon which provide more clarity about the role of mental lexicon and how it functions, and moreover it confirms how Lexical items are accessed, acquired and ordered in the mind. A comparative between the physical dictionaries and the mental dictionary (Mental lexicon) has discussed in this paper in order to mention the similarities and differences between them and to have deep understanding about the concept of mental lexicon. The role of mental lexicon in the process of language learning and language teaching is also elaborated. On the basis of this research it could be concluded that mental lexicon is enchanting topic that touches on all aspects of psycholinguistic, it is undoubtedly much more flexible and complex than any book dictionary and there are many points of view from which to study. Accordingly there is still other discussions about which model is best, even whether it is sensible to produce a globally serviceable model. We have to remember that each model has its own advantages and each model has discussed in this paper has expanded our knowledge and deepen our understanding of the mental lexicon in valuable manner.

ACKNOWLEDGMENT

We would like to take this opportunity to express praise and to thank Allah for giving us the opportunity to write this work. We are also grateful to Dr. Alaa Musallam Albkour for his support and corporation.

REFERENCES

- [1] Andrews, Sally (September 1989). "Frequency and Neighborhood Effects on Lexical Access: Activation or Search?". *Journal of Experimental Psychology: Learning, Memory, and Cognition* **15** (5). doi:10.1037/0278-7393.15.5.802 W.-K. Chen, *Linear Networks and Systems* (Book style). Belmont, CA: Wadsworth, 1993, pp. 123–135.
- [2] Carter, Ronald, and Michael McCarthy. *Vocabulary and language teaching*. Routledge, 2014.
- [3] Contemporary Linguistic Analysis (5th Custom Edition for U of A). Toronto, ON: Pearson Custom Publishing, 2008.
- [4] Elman, Jeffrey L. "An alternative view of the mental lexicon." *Trends in cognitive sciences* 8.7 (2004): 301-306.
- [5] Forster, K. I. . Accessing the mental lexicon. In F. Wales & E. Walker (Eds). *New approaches to language mechanisms* (p. 257-287). Amsterdam: North Holland, 1976.
- [6] Jackendoff, Ray. *Foundations of language: Brain, meaning, grammar, evolution*. Oxford University Press, 2002.
- [7] Jean Aitchison, *Words in the Mind: An Introduction to the Mental Lexicon*. Wiley-Blackwell, 2003

- [8] John F. Sowa. "Semantic Networks". In Stuart C Shapiro, (1987). *Encyclopedia of Artificial Intelligence*. Retrieved 2008-04-29
- [9] Marcus Taft, *Reading and the Mental Lexicon*. Psychology Press, 1991
- [10] Miller, George A. "Dictionaries in the Mind." *Language and Cognitive Processes* 1.3 (1986): 171-185.
- [11] Nattinger, James. "Some current trends in vocabulary teaching." *Vocabulary and language teaching* (1988): 62-82.
- [12] Noam Chomsky. "Tool Module: Chomsky's Universal Grammar" . Retrieved 2015-10-07.
- [13] Reed, Stephen. *Cognition: Theories and applications*. CENGAGE learning, 2012.
- [14] Russell, Stuart. "Artificial intelligence: A modern approach author: Stuart russell, peter norvig, publisher: Prentice hall pa." (2009).
- [15] Sternberg, R. J. *Cognitive theory* (3rd ed.). Belmont, CA: Thomson Wadsworth, 2003
- [16] Traxler, Matthew J. *Introduction to psycholinguistics: Understanding language science*. John Wiley & Sons, 2011.

AUTHORS

First Author – Othman Aref Al Dala'ien, research scholar, Aligarh Muslim University AMU, Othman.dalain@yahoo.com
Second Author -- Badri Abdulhakim D.M. Mudhsh, research scholar, Aligarh Muslim University AMU ,badrimudhsh@yahoo.com
Third Author — Ayman Hamid Al-Takhayinh, research scholar, Aligarh Muslim University AMU, aymantakhayinh@yahoo.com
Correspondence Author – Othman Aref Al Dala'ien, Othman.dalain@yahoo.com, 00917060314176

Pattern of Dyslipidemia in Diabetes Mellitus

Dr. Musa Khan, M.D. *, Dr. P. Sakuntala, M.D. *, Dr. R. Siddeswari, M.D. **, Dr. B. Sudarsi, M.D. *

* Asst Prof. of Medicine ; Osmania Medical College / Osmania General Hospital, Telangana State, Hyderabad.

** Prof. of Medicine ; Osmania Medical College / Osmania General Hospital, Telangana State, Hyderabad.

Abstract- Diabetes Mellitus being panmetabolic disorder is characterized by alteration in lipid profile. Although diabetes and hyperlipidemia represent different genetic disorders, each of these disorders is common in the general population and the two disorders may co-exist in the same individual.

This study of lipid profile in diabetics is undertaken to see how often hyperlipidemias are associated with diabetes mellitus. This case control study consists 100 patients, 50 with diabetes and 50 with non diabetic controls. Type of diabetes, diabetic treatment were recorded fasting lipid profile was done in both controls and diabetics and levels were compared. Marked elevation of triglycerides, total cholesterol and low density lipoproteins and lower levels of serum HDL cholesterol were observed in both types of diabetes when compared to controls.

Index Terms- Diabetes Mellitus (DM), Dyslipidemia, Type 1 & Type 2 Diabetes and Fasting Blood Sugar (FBS)

I. INTRODUCTION

The worldwide prevalence of DM has risen dramatically over the past two decades, from an estimated 30 million cases in 1985 to 285 million in 2010. Based on current trends, the International Diabetes Federation projects that 438 million individuals will have diabetes by the year 2030.

Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Several distinct types of DM are caused by a complex interaction of genetics and environmental factors. Depending on the etiology of the DM, The metabolic dysregulation associated with DM causes secondary pathophysiologic changes in multiple organ systems that impose a tremendous burden on the individual with diabetes and on the health care system¹

The main types of diabetes are type 1 and type 2 diabetes. Type 1 diabetes results from an irreversible loss of pancreatic B-cells and type-2 diabetes is primarily caused by impaired insulin action⁷

DM if left untreated diabetes can lead to serious problems like macrovascular and microvascular complications. The microvascular complications include retinopathy, nephropathy, and neuropathy (both distal polyneuropathy and autonomic neuropathy)⁵ while the macrovascular complications of diabetes include angina, myocardial infarction, transient ischemic attack, and stroke³

Diabetes is commonly associated with abnormalities in plasma lipids and lipoprotein levels commonly referred to as "dyslipidemia" .about 50% of all diabetic patients have

dyslipidemia. Lipid abnormalities are more common in type 2 diabetes than in type 1 diabetes.⁶

Individuals with DM may have several forms of dyslipidemia (Chap. 356). The most common pattern of dyslipidemia is hyper triglyceridemia and reduced HDL cholesterol levels. DM itself does not increase levels of LDL, but the small dense LDL particles found in type 2 DM are more atherogenic because they are more easily glycosylated and susceptible to oxidation.

According to guidelines of the ADA and the American Heart Association, the target lipid values in diabetic individuals (age >40 years) without cardiovascular disease should be as follows: LDL < 2.6 mmol/L (100 mg/dL); HDL >1 mmol/L (40 mg/dL) in men and >1.3 mmol/L (50 mg/dL) in women; and triglycerides <1.7 mmol/L (150 mg/dL). In patients >40 years, the ADA recommends addition of a statin, regardless of the LDL level in patients with CHD and those without CHD, but who have CHD risk factors.¹

The rationale of this study was to detect lipid abnormalities pattern in both type 1 and type 2 diabetes mellitus.

II. METHODS

In our series we studied 50 healthy non diabetic volunteers as controls and in the second group we studied 50 of cases of uncomplicated diabetes mellitus. These cases were randomly selected from the in-patient and out-patient services of Government General Hospital, Kurnool. The patients belonging to both insulin dependent diabetes mellitus as well as non insulin dependent diabetes mellitus were chosen.

The patients were investigated after a through clinical check up. Blood was drawn from all patients for the study of FBS and serum lipids. After 12 hours over night fasting 10ml of venous blood was drawn into a dry test tube, serum was separated by keeping it in a slanting position on a wooden rack. The separated serum was analyzed for the following.

1. Naked eye examination of examination of plasma kept at 4° C for 16hrs for the observance of any cream formation on top by the chylomicrons or for the general turbidity of the plasma due to very low density lipoproteins.
2. Serum HDL cholesterol by phosphotungstic acid magnesium method (Ref. Practical Clinical Chemistry by Harold Varley).
3. Serum LDL cholesterol, by Freidweld method (Clinical diagnosis and management by laboratory methods, Todd, Sanford Davidson 12th Edition).

Table showing demography and lipid profile in type 1 diabetes

S.No	Sex	Age	Type of DM	Duration	OHA / Insulin	FBS	Total Cholesterol	Tri glycerides	HD L	LD L	VLD L
1	M	25	1	8 yrs	Insulin	125	237	180	35	166	36
2	M	25	1	2 yrs	Insulin	120	242	175	33	174	35
3	M	25	1	2 yrs	Insulin	120	244	150	38	176	30
4	M	20	1	4 yrs	Insulin	170	208	380	37	95	76
5	M	25	1	3 yrs	Insulin	160	264	325	33	166	65
6	M	20	1	6 yrs	Insulin	170	284	365	37	174	73
7	F	20	1	5 yrs	Insulin	160	269	361	31	166	72
8	M	25	1	3 yrs	Insulin	125	291	175	38	218	35
9	F	22	1	2 yrs	Insulin	145	342	340	33	241	68
10	F	21	1	5 yrs	Insulin	120	330	275	29	246	55
11	F	25	1	2 yrs	insulin	140	294	350	37	187	70
12	F	26	1	2 yrs	Insulin	120	203	280	31	116	56
13	F	25	1	3 yrs	Insulin	135	240	381	32	132	76
14	M	30	1	9 yrs	Insulin	140	282	380	30	176	76
15	M	25	1	2 yrs	Insulin	120	213	238	33	132	48
16	M	23	1	4 yrs	Insulin	120	220	175	28	157	35
17	F	30	1	7 yrs	Insulin	160	170	370	28	68	74
18	F	25	1	2 yrs	Insulin	170	295	339	33	194	68
19	M	19	1	6 yrs	Insulin	130	315	250	33	232	50
20	F	24	1	9 yrs	Insulin	120	279	167	27	219	33
21	M	23	1	8 yrs	Insulin	140	269	325	30	174	65
22	M	21	1	7 yrs	Insulin	150	242	350	38	134	70
23	F	22	1	2 yrs	Insulin	120	349	130	33	290	26
24	M	22	1	8 yrs	Insulin	150	306	325	27	214	65

III. RESULTS

We randomly selected 50 controls from healthy volunteers of whom 26 were males and 24 were females, the mean age being 32.5 years. We made a random selection of 50 diabetic patients, Type 1 DM n=24 of whom 14 were males and 10 were females and Type 2DM n=26 of whom 15 were males and 11 were females. Mean age in type 1 diabetes is 24.4 and type 2 diabetes is 44.7.

Table showing Demography and Lipid Profile in Type 2 Diabetes

S.No	Sex	Age	Type of DM	Duration	OHA / Insulin	FBS	Total Cholesterol	Triglycerides	HD L	LDL	VLD L
1	M	58	2	10 yrs	OHA	140	243	285	32	154	57
2	M	40	2	10 yrs	OHA	148	340	226	28	267	45
3	F	35	2	1 yr	OHA	130	333	170	26	273	34
4	F	40	2	4 yrs	OHA	140	220	388	34	108	78
5	F	46	2	8 yrs	OHA	135	287	224	31	211	45

6	M	50	2	2 yrs	OHA	150	243	345	34	140	69
7	F	40	2	2 yrs	OHA	140	325	280	30	239	56
8	M	36	2	1 yr	OHA	125	264	160	37	195	32
9	M	42	2	2 yrs	OHA	160	260	330	39	155	66
10	F	44	2	4 yrs	OHA	145	277	350	38	169	70
11	M	55	2	4 yrs	OHA	150	285	340	30	187	68
12	M	45	2	6 yrs	OHA	145	279	300	32	187	60
13	M	54	2	8 yrs	OHA	125	257	228	36	175	46
14	M	40	2	7 yrs	OHA	150	323	346	36	218	69
15	M	50	2	9 yrs	OHA	120	286	232	33	207	46
16	M	22	2	4 yrs	Insulin	125	206	187	33	136	37
17	M	46	2	2 yrs	OHA	135	260	333	39	154	67
18	F	40	2	5 yrs	Insulin	125	227	150	30	167	30
19	M	42	2	10 yrs	OHA	130	272	287	35	180	57
20	F	50	2	5 yrs	OHA	125	239	250	36	153	50
21	F	42	2	5 yrs	OHA	130	240	350	39	131	70
22	M	56	2	2 yrs	OHA	145	292	380	36	180	76
23	F	44	2	3 yrs	OHA	145	303	350	36	197	70
24	F	30	2	5 yrs	OHA	130	287	185	38	212	37
25	M	50	2	6 yrs	OHA	150	248	300	39	149	60
26	M	40	2	5 yrs	OHA	120	202	100	26	156	20

Table showing demography and lipid profile in controls

S.NO	SEX	AGE	FBS	TC	TG	HDL	LDL	VLDL
1	M	45	75	183	106	30	132	21
2	M	40	82	130	80	37	77	16
3	F	42	74	130	109	36	72	22
4	M	36	81	143	92	32	93	18
5	M	51	65	174	151	36	108	30
6	F	43	81	134	62	30	92	12
7	M	52	72	192	85	38	137	17
8	F	37	75	192	76	39	138	15
9	M	48	80	148	116	31	94	23
10	M	36	75	108	130	30	52	26
11	M	56	90	172	123	35	112	25
12	F	38	80	188	120	33	131	24
13	M	40	65	196	126	36	135	25
14	F	43	75	153	123	37	91	25
15	M	42	86	178	146	35	114	29
16	F	50	90	193	133	41	125	27
17	M	45	72	144	121	39	81	24

18	F	36	65	194	141	40	126	28
19	M	41	80	198	139	35	135	28
20	M	43	85	178	137	39	112	27
21	M	39	81	199	152	42	127	30
22	F	46	64	184	138	39	117	28
23	M	51	62	195	116	44	128	23
24	M	46	69	153	120	38	91	24
25	F	43	70	199	126	37	137	25
26	M	45	62	168	112	40	84	44
27	F	34	80	135	70	34	67	14
28	M	39	86	175	100	43	92	20
29	F	40	75	163	130	46	78	26
30	M	41	84	152	132	42	84	26
31	F	34	82	197	67	45	139	15
32	F	52	84	168	130	38	104	26
33	M	42	84	198	153	36	113	30
34	F	37	82	197	115	41	123	23
35	M	38	84	205	133	38	120	37
36	F	42	82	207	150	44	130	33
37	F	40	75	162	125	40	97	25
38	F	38	71	194	128	30	138	26
39	M	42	76	183	151	71	70	42
40	F	36	72	162	122	38	111	24
41	F	38	84	166	131	47	93	26
42	F	40	86	153	154	43	77	31
43	M	41	75	150	91	45	88	18
44	F	30	74	181	85	45	109	17
45	M	39	72	196	126	42	117	37
46	F	41	79	201	113	36	143	22
47	M	49	80	170	126	33	123	24
48	F	36	82	182	130	36	145	21
49	M	37	86	167	123	38	135	32
50	F	40	89	189	122	36	116	25

TABLE SHOWING CORRELATION OF FBS WITH LIPID PROFILE

GROUP	MEAN FBS	MEAN TG	MEAN TC	MEAN LDL	MEAN HDL
controls	77.5	132	175	117	31
type1DM	138.5	288	220	127	27
type 2DM	147.42	300	221	136	25

The following table shows that there is elevation of in total cholesterol, LDL cholesterol levels and triglycerides while the HDL cholesterol showing a decrease in Type 1 DM and

Type2DM groups compared to the control group correlating with the Fasting blood sugar levels.

Number of patients in controls, type 1 diabetes and type 2 diabetes with total cholesterol >200mg/dl are n=3, n=23 and n=26 respectively, triglycerides >150mg/dl are n=6, n=24 and n=24, low density lipoprotein cholesterol >100 mg/dl are n=27, n=23 and n=26. and high density lipoprotein cholesterol <40 mg/dl in males and <50 mg/dl in females are n= 21/19, n=14/18 and 16/10 respectively. There is significant abnormality in lipid profile in both type 1 and type 2 diabetics when compared to controls.

IV. DISCUSSION

The cost of diabetes care is high and is escalating worldwide. It is estimated by the WHO that the global expenditure for diabetes care would increase from 234 Billion in 2007 to 411 Billion in the next 20 years. The WHO estimate is based on lost productivity due to diabetes, heart diseases, and stroke together show that over the next 10 years, lost national income in billions of USD will amount 336.6 in India²

Carbohydrate metabolism in type 2 diabetes

People with T2DM have elevated fasting glucose levels and excessive glycemic excursions following carbohydrate ingestion. Insulin secretion in those with T2DM is typically decreased and delayed following food ingestion^{11,10}. Defects in insulin secretion are observed early in the evolution of T2DM. In fact, alterations in both the timing and amount of insulin secreted have been reported in relatives of patients with T2DM prior to the development of hyperglycemia.

Chronic hyperglycemia alone or in combination with elevated FFA impairs insulin secretion. Abnormalities in glucose sensing insulin processing or intracellular signalling can alter insulin secretion⁹. In addition, Beta cell mass decreases with increasing duration of diabetes⁸. Alterations in beta cell morphology occur in most people with T2DM with extensive intra islet deposition of amylin commonly being observed⁴.

Lipid levels and their interpretations in different type of DM Type 1 DM: This is a typical situation where insulin production is minimal to nil and therefore its concentration is low both in the porto hepatic circulation and peripheral blood. The lipoprotein composition is accordingly affected with low high density lipoprotein cholesterol (HDL-C), poor esterification of cholesterol, more of TG with less VLDL clearance. This is more so in inadequately treated patients with poor glycemic control. The activity of enzymes like lecithin cholesterol acyl transferase (L-CAT) and lipases are suppressed due to low circulating insulin levels. This adversely affects HDL metabolism. Besides, higher concentration of free cholesterol in low density lipoprotein (LDL) and intermediate density lipoprotein (LDL) makes them more atherogenic. However, institution of insulin treatment and maintenance of euglycemia rapidly reverses lipid metabolism to normal.

Type 2 DM: In patients with type 2 DM there is global dysfunction of lipoprotein metabolism. The degree of dyslipidemia is more widespread. There is increase in small dense LDL (LDL3) which is highly atherogenic. In patients with poor glycemic control, levels of TG rich lipoproteins are higher.

The HDL levels may not be low in these type of diabetic subjects, more so with fair glycemic control⁵.

V. CONCLUSION

A study of fifty uncomplicated diabetic patients was taken-up to see how often hyperlipidemia is associated with diabetes mellitus. There is a high incidence of hyperlipidemias among uncontrolled diabetic patients. There is no significant correlation between the duration of diabetes and the tendency for abnormal lipid profile pattern.

In both Type 1 DM and Type 2 DM groups the serum triglycerides showed a significant elevation. The serum total cholesterol and serum LDL cholesterol also showed a definite elevation. The serum HDL cholesterol showed a decrease in both Type 1 DM and Type 2 DM patients.

Because of the additive cardiovascular risk of hyperglycemia and hyperlipidemia, lipid abnormalities should be assessed aggressively and treated as part of comprehensive diabetes care.

REFERENCES

- [1] Alvin C. Powers (2012) CH 344 diabetes Mellitus, Harrison's text book of internal medicine., Mc Graw Hill's pub Vol. 2, 18th edition, pg no 2968.
- [2] Ramachandran, C. Snehalath (2012) 9.1 Epidemiology and Basic Considerations of Diabetes API Text book of Medicine Y.P. Munjal vol 1 9th edition pg 321.
- [3] Bottle A, (1996-2005) Et al., Millet C., Trends in cardiovascular admissions and procedure for people with and without diabetes in England., Diabetologia 2009;52:74-80. (gomal journal of medical sciences July-Dec, 2011 vol 9, no.2 EVALUATION OF PATTERN OF DYSLIPIDEMIA IN TYPE 2 DIABETICS IN SWAT., Sahibzada Saeed Jan et al)
- [4] Edghill EI (2006), et al, HLA genotyping supports a nonautoimmune etiology in patients diagnosed with diabetes under the age of 6 months. Diabetes ; 55 : 1895 – 1898. (Textbook of Diabetes 4th edition.. edited by Richarg I G Holt ; Published by Wiley Black Well).
- [5] Frier B (2006) et al., Diabetes, aging and physical activity. Eur Rev Aging Phys Act; 3:63-73.
- [6] GR Ravi Mohan and sidhartha das Diabetes mellitus and Dyslipidemia - Eprints@MDRF mdrf-eprints.in/473/1/Diabetes_mellitus_and_Dyslipidemia.pdf, .moses manual ch 40, pg no 371-374.
- [7] Meier JJ (2008). Beta cell mass in diabetes. Diabetologia; 51:703-13.)
- [8] Neve B, et al. Role of transcription factor KLF11 and its diabetes – associated gene variants in pancreatic beta cell function. Proc Natl Acad Sci U S A ; 102 : 4807 – 4812.
- [9] Plengvidhya N 2007, et al. PAX 4 mutations in Thais with maturity onset diabetes of the young. J. Clin Endocrinol metab; 92:2821 – 2826.
- [10] Spyer G (2001), Hattersley et al. Influence of maternal and fetal glucokinase mutations in gestational diabetes. Am J Obstet Gynecol; 185 : 240-241.
- [11] Velho G (1996), et al Impaired hepatic glycogen synthesis in glucokinase deficient (MODY – 2) Subjects. J Clin Invest ; 98 : 1755 – 1761.

AUTHORS

First Author – Dr. Musa Khan, M.D., Asst Prof of Medicine; Osmania Medical College / Osmania General Hospital, Telangana State, Hyderabad.
Second Author – Dr. P. Sakuntala, M.D., Asst Prof of Medicine; Osmania Medical College / Osmania General Hospital, Telangana State, Hyderabad.
Third Author – Dr. R. Siddeswari, M.D., Prof. of Medicine; Osmania Medical College / Osmania General Hospital, Telangana State, Hyderabad.

Fourth Author – Dr. B. Sudarsi, M.D., Asst Prof. of Medicine ; Telangana State, Hyderabad.
Osmania Medical College / Osmania General Hospital,

Realtime Epileptic Seizures Detection and Alert System Using NI Lab-View

M. Anil kumar¹, S. Kishore², N. Karthik³, K. Chandra sekhar⁴, Shaik Shafi⁵, M.C.Chinnaiah⁶

Students^{1,2,3,4} ECE, B.V.Raju institute of technology, Medak, Telangana, India.
Faculty^{5,6} ECE, B.V.Raju institute of technology, Medak, Telangana, India.

Abstract- For people who have been are suffering from epileptic seizures, a real time system is developed which is helpful in detecting such cases, is Smart epilepsy detection and alert system is an advanced technology by which we have developed a electronic gadget. Using that kit we can save the life of the person who is really effecting with the condition. It will do the help in both the ways means not only checks the condition but also sends an SMS to the concerned doctor for the patient's live saving sake. To implement all the above process we have used mainly four modules micro controller KEIL module, ARDUINO module, GSM module to send an SMS, and LABVIEW.

Index Terms- GSM, ARDUINO, Lab-View.

I. INTRODUCTION

The main aim of the project is to provide a electronic gadget for the epilepsy patients to protect themselves from the *seizures* and heart attacks. Not only will that it also intimate the respective doctors about the patient's condition. The electronic system presented here is a wearable device which predicts the occurrence of epilepsy in a few minutes advance. The device utilizes the signals from human body to detect the occurrence of epilepsy. As soon as the device detects the symptoms, it transmits a coded signal. The signal is decoded by a wireless receiver to produce control signals for switching an alarm device, mobile messaging device and an automatic vehicle control system appropriately. In future, GPS could be incorporated to trace out the exact location of the patient.

II. LITERATURE SURVEY

Current technologies for acquiring signals from the patient's body are very much developed. Many sensors are available which can detect the heart beat and muscular movements non-invasively and accurately. Such non invasive technique for measuring heart beat is pulse oxymetry. Using this technique, heart beat can be accurately monitored. Muscular convulsions are collected using micro electromechanical sensors (MEMS) firmly attached to the body. The sensors used are small in size and can be firmly attached to the body. The accelerations resulting from epileptic convulsions are sensed using MEMS accelerometer which is very accurate, precise and small in size.

To provide wireless communication channel low cost network using MiWi protocol is utilized. MiWi is a standard protocol developed by Microchip Inc, USA, based on IEEE 802.15.4. Heart beats are to be monitored continuously. Any

sudden variation in heart beat which is caused by the onset of epileptic seizures is detected and confirmed with the MEMS signal. When the seizure is confirmed, message is transmitted to the surroundings for initiating necessary protective measures for the patient.

The device is designed as wireless, wearable and personal equipment. The device can sense the aura of parietal stage in a few minutes advance and takes the necessary safety measures automatically. Hence a technician's assistance is not required for the patient. Therefore this device will be extremely useful for patients (especially youngsters) who wish to be active in their life. The user gets absolute freedom from wires and can be used when moving. To practically implements the epilepsy prediction system, the following aspects should be implemented. Sensing biometric signals: Two types of biological signals are required for processing. They are heart beat and muscular convulsions. The heart beat can be measured using pulse oxy meter and muscular movements can be measured using mems sensor. Processing it and taking decisions: Processing of the signals is done by software programmed into a microcontroller. The software is designed in such a way that it detects the exact symptom of epilepsy.

III. PROPOSED SYSTEM DESIGN

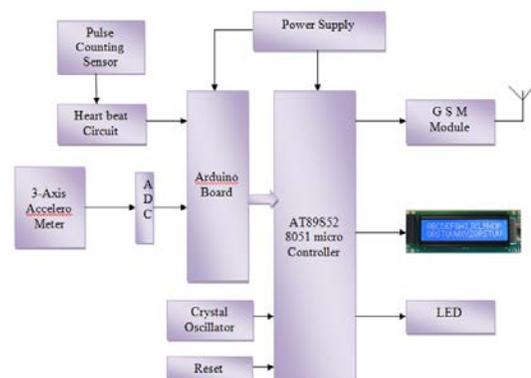


Fig.1: Block Diagram of smart epilepsy detection and alert system

The design consists of hardware and software sections. The device hardware mainly consist of three parts namely, (i) Heart beat sensor, (ii) Seizure detector, (iii) Processor and (iv) Wireless transceiver

(i) Heart beat sensor: The heart beat of the patient is to be monitored accurately. For this purpose, a pulse oxy meter is used. Pulse oxy meter measures heart beat by sensing the difference in absorbance of infrared radiation by blood during systolic and diastolic activities of heart. The volume of blood flowing through arteries varies widely during each heart beat. Hence if infrared radiation is incident on it, the absorbance of IR also varies according to the heart beat. These variations are sensed using a photo detector to determine the heart beat.

The pulse oxy meter designed here works using reflective principle. The IR source emits IR radiation which is reflected in accordance with the flow of blood. The reflected rays are detected using a photo detector. A sensor is placed on a thin part of the patient's anatomy, usually a fingertip or earlobe, and light of infrared wavelength is made incident on the body. Changing absorbance of the infrared is measured, allowing determination of the absorbance's due to the pulsing arterial blood alone, excluding venous blood, skin, bone, muscle, fat, and (in most cases) fingernail polish. The circuit of pulse oxy meter consists of a trans-resistance amplifier, voltage follower, difference amplifier, and filter. All these stages are cascaded together to form the complete circuit of pulse oxy meter. The circuit works in 5 V supply. In order to get perfect amplification sans noise, ultra low offset operational amplifier

OP07 and FET input operational amplifier LF 356N is selected.

A trans resistance amplifier is used in the first stage to convert the photodiode current to voltage. The major design parameter of this sensor is its output voltage and the output frequency. The output frequency is band limited to 15 Hz using filters. Low pass first order butterworth filter is used. Low pass filter is designed at 15 Hz upper cut off frequency with a gain of 1.5. A high pass first order butter worth filter with lower cut off frequency of 0.5 Hz is cascaded with the low pass to remove the dc voltage. An amplifier is set at the output of the meter in order to raise the output signal level to +5V (approx). Amplifier with amplification factor of 50 is designed. Typical output of the sensor is shown on the graph below. Normal heart beat is 72 beats per minute. That is the frequency of the signal is 1.2 Hz for a healthy person. The output amplitude varies from 70mV to 120mV

(ii) Seizure detector: Seizures are involuntary muscular movements which occur during epilepsy. Muscular movements are sensed using MEMS (micro electro mechanical sensor) accelerometer. A 3D accelerometer is used to sense the muscular movements. The ADXL330 is a low cost, low power, complete 3-axis accelerometer with signal conditioned voltage outputs, which is all on a single monolithic IC. The ADXL330 is a complete acceleration measurement system on a single monolithic IC. The ADXL330 has a measurement range of ± 5 g. The sensor is a polysilicon surface-micro machined structure built on top of a silicon wafer. Polysilicon springs suspend the structure over the surface of the wafer and provide a resistance against acceleration forces. Deflection of the structure is measured using a differential capacitor that consists of independent fixed plates and plates attached to the moving mass. The fixed plates are driven by 180° out-of-phase square waves. Acceleration deflects the beam and unbalances the differential capacitor, resulting in an output square wave whose amplitude is

proportional to acceleration. Phase-sensitive demodulation techniques are then used to rectify the signal and determine the direction of the acceleration.

(iii)Processor: The signals from sensors are processed using PIC18F4620 microcontroller. The microcontroller requires a 10 bit ADC and a comparator circuit for processing the signals from the sensor. PIC 18F 4620 includes built in ADC and comparator. The processor is clocked at 4MHz. The frequency of normal heart beat rate is 1.2 HZ. Approximately. Or the time period of the heart beat signal is 0.83 secs. The algorithm detects the sudden decrease in pulse width which is one of the aura of epilepsy. As soon as the variations in the heart beat are detected, the algorithm checks for the typical seizure waveform from the mems sensor. When these two signals coincide, the software takes the decision as an epileptic seizure and generates control signals.

(iv) GSM Module:



Fig.2: GSM Module

GSM (Global System for Mobile) / GPRS (General Packet Radio Service) TTL –Modem is SIM900 Quad-band GSM / GPRS device, works on frequencies 850 MHz, 900 MHz, 1800 MHz and 1900 MHz. It is very compact in size and easy to use as plug in GSM Modem. The Modem is designed with 3V3 and 5V DC TTL interfacing circuitry, which allows User to directly interface with 5V Microcontrollers (PIC, AVR, Arduino, 8051, etc.) as well as 3V3 Microcontrollers (ARM, ARM Cortex XX, etc.). The baud rate can be configurable from 9600- 115200 bps through AT (Attention) commands. This GSM/GPRS TTL Modem has internal TCP/IP stack to enable User to connect with internet through GPRS feature. It is suitable for SMS as well as DATA transfer application in mobile phone to mobile phone interface. The modem can be interfaced with a Microcontroller using USART (Universal Synchronous Asynchronous Receiver and Transmitter) feature (serial communication).

IV. DESIGN IMPLEMENTATION

The processing unit utilizes the logic implemented in the software for accurate detection of seizures. The software checks the input signal from the pulse oxy meter from the patient's body continuously and measures the pulse width of the signal. This width is converted into heartbeat rate by the software. If there is any abnormalities in heart beat, it can be detected as a change in the pulse width .As soon as the logic detects a change it triggers the vibrator and the system waits for the response. The patient

has to press a button on his wearable unit. If the patient is unable to do so due to occurrence of seizure, then response signal from MEMS sensor which senses the muscular convulsions is captured and analyzed. If there are signals of muscular convulsions the software concludes that the patient has seizure and warning message is transmitted using the wireless transmitter. The seizure detection algorithm from the MEMS signals is to check only the sudden abnormality occurring in the human body. This algorithm helps to avoid situations where heart beat rises due to excessive physical work or due to tension etc. The algorithm uses the averaging technique to determine abnormalities accurately. $P = (P+N)/2$ where p=previous heart beat rate N=next heart beat rate. For a person suffering from epilepsy, in the pre ictal stage the heart beat varies abruptly and hence the value of P also changes. This change in the value of P is detected and the program is made to wait for the signal from the second sensor which senses the muscular convulsions. If muscular convulsions are detected from the second sensor, it triggers the transmitter on which transmits a coded signal which is received by the receiver. The software section contains the following major functional modules:

1. Heart beat rate calculations
2. Seizure detection from MEMS signal
3. Communication control
4. Overall supervision

The system requires a heart beat sensor, muscular convulsion Sensor, a transmitter, receiver, mobile messaging device, alarm device and automatic vehicle control system. All the above said parts are integrated together to a processor to form the device. The epilepsy prediction system can be practically implemented by incorporating the following components

a) Heart beat sensor: A pulse oxy meter is used as a heart beat sensor.

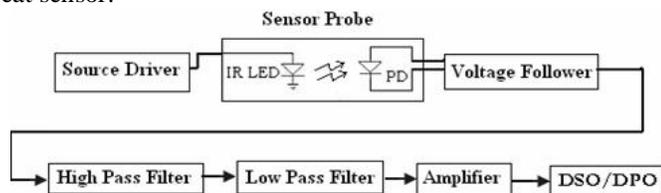


Fig. 3: Block schematic of pulse-oxy meter

The implementation of pulse oxy meter is by cascading several stages as shown in the figure 4. A high pass filter is designed with lower cutoff frequency of 15 Hz. the high pass filter is cascaded with a low pass filter designed to an upper cut off frequency of 0.5 Hz. The amplifier at the final stage raises the voltage from mV level to the required voltage range. An amplification factor of 50 is given to it.

b) Convulsions sensor: An accelerometer is used as a convulsion sensor. Muscular convulsions are detected using single axis mems ICMMA1260EG. The sensitivity of the sensor is set to 1.55g. The circuit is implemented as shown in the circuit diagram. The output of the sensor is filtered out sing a low pass RC filter externally. The value of R is selected as 1KΩ and C as 0.1μf.

c) Processing unit: The processing unit contains PIC

18F4620 microcontroller which is clocked at 40 MHz.. PIC18F4620 have 64 Kbytes of Flash memory. The microcontroller has inbuilt 10 bit ADC which is used to digitize the output from MEMS module. It also includes a comparator which is used to process the heart beat waveforms from the pulse oxy meter. The incoming signal is processed using logics implemented in the software which runs the device. The processing unit continuously checks for symptoms in the incoming signal. As soon as it detects any abnormality, it triggers a warning vibrator and the wireless transmitter.

d) GSM module

Using the GSM module in the kit to send an SMS to the guardian and the doctor who will take care of the patient in the hospitals. GSM module code we have dumped in the 8051 micro controller using the KEIL software.

e) Enclosure design

The device is a wearable one (on the wrist). Hence the enclosure is designed suiting to that purpose. The enclosure can be designed in the form of a watch.

V. TESTING



Fig.4: Pulse Oxy meter and its principle of operation

(i) Testing of Pulse oxy meter: The pulse oxy meter was tested by wounding the probe of the device on the index finger of a person and the output were viewed on a DSO. The output is shown in the graph given below. The pulse oxy meter successfully detected the heart beat waveform from the patient's index finger. The out put frequency was 1.2 Hz . And the voltage level was in the range of 100 to 120 mV.

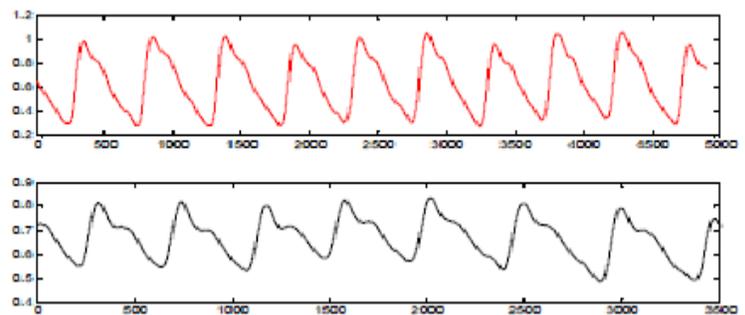


Fig.5: Output graphical wave form from pulse oxy meter

(ii) Testing of MEMS sensor:

The MEMS sensor is connected to the body of the patient using straps. Typical epileptic seizure waveform is shown in the

figure below. The sensor output is expected to be of the shape as shown below. This stage is not yet fully tested and testing is under way.

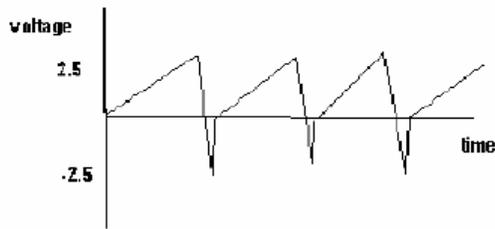


Fig. 6: Typical signal from the MEMS sensor during seizure

(iii) Testing of software:

The inputs from the sensors were provided to the PIC controller in which the software was programmed. Wave forms describing different conditions of the patient were given as input and tested successfully.

(iv) Testing of communication module

The transceiver is directly connected to the microcontroller in which the software was programmed. As soon as the software detected the epileptic symptom, the transmitter was triggered. Using Zena network analyzer, the network was detected at a frequency of 2.4G Hz. A peer to peer single node network was formed which transmitted the message to the receiver node. The system designed here processes the heart beat continuously and abnormalities are detected accurately. The device transmits the signal only when seizures of epilepsy are detected. The performance of the device is not restricted by movement of the patient. By using this device the patient can move freely without worries

VI. LABVIEW

We have used NI labview to interconnect the sensors and as the input output lines through the Arduino board. Lab view is a software we are using this through the laptop to show the results like the condition of the patient at the time of getting effected with the suizers and heart attacks. And to run the process when the person encountered the situation then we can observe the condition through the MEMS and ECG screens provided on the screen of the laptop in the labview module.

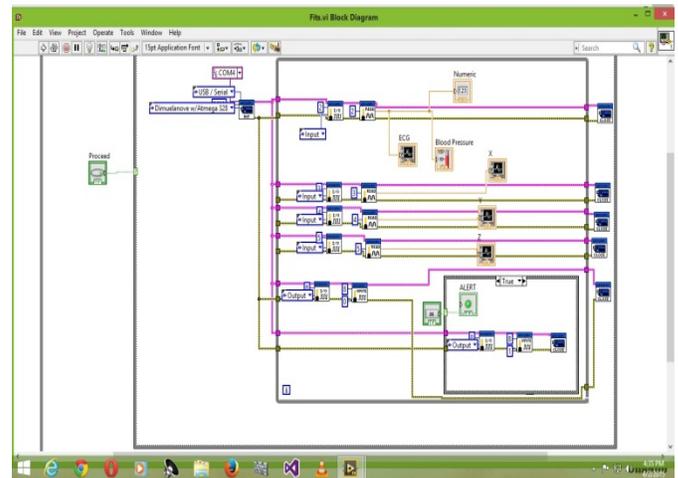


Fig.7: Lab VIEW circuit diagram

VII. RESULTS

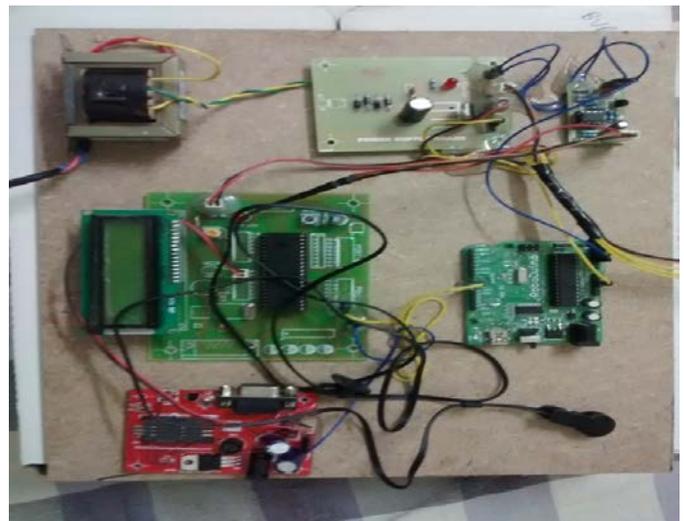


Fig.8: Epilepsy kit with the arduino and gsm module

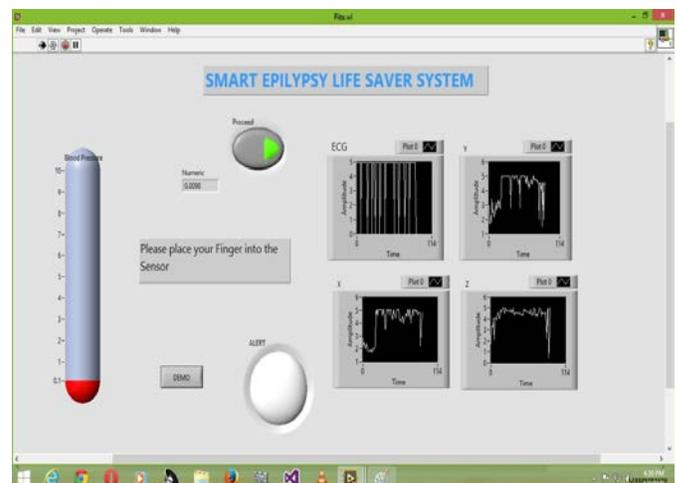


Fig.9: Lab view results

VIII. CONCLUSION

A light weight, rugged, cost-effective wearable device is developed which helps millions of victims of epilepsy around the globe. With the device in possession an epilepsy victim can move around freely like normal people sans worries. The system is easily expandable to incorporate GPS system and to capture and transmit various patient parameters like ECG, body temperature etc. We can further extend the project when the patient is driving in the traffic places then we can include the GPS system to trace the exact location of the patient and take the necessary action

REFERENCES

- [1] J. F. Annegers and S. P. Coan, "SUDEP: Overview of definitions and review of incidence data," *Seizure: European Journal of Epilepsy*, vol. 8,(6), pp. 347-352, 1999.
- [2] O. Devinsky, "Sudden, unexpected death in epilepsy," *New England Journal of Medicine*, vol. 365, no. 19, pp. 1801-1811, 2011.
- [3] S. Beniczky, T. Polster, T. W. Kjaer, and H. Hjalgrim, "Detection of generalized tonic-clonic seizures by a wireless wrist accelerometer: A prospective, multicenter study," *Epilepsia*, vol. 54(4), pp. 58-61, 2013
- [4] K. V. Poppel, S. P. Fulton, A. McGregor, M. Ellis, A. Patters, and J. Wheless, "Prospective Study of the Emfit Movement Monitor," *J Child Neurol*, vol. 00(0), pp. 1-3, 2013.
- [5] S. Gouravajhala, D. Wang, L. Khuon, and F. Bao, "EpSMART: Epileptic seizure monitoring with alerts in real time: A tablet-based Android application for a real-time multi-modal seizure detection system," in *Bioinformatics and Biomedicine Workshops (BIBMW)*, 2012 IEEE International Conference on, 2012, pp. 959-961.

- [6] K. Cuppens, B. Vanrumste, B. Ceulemans, L. Lagae, and S. Van Huffel, "Detection of epileptic seizures using video data," in *Intelligent Environments (IE)*, 2010 Sixth International Conference on, 2010, pp. 372-373.
- [7] M.-Z. Poh, T. Loddenkemper, C. Reinsberger, N. C. Swenson, S. Goyal, M. C. Sabtala, J. R. Madsen, and R. W. Picard, "Convulsive seizure detection using a wrist-worn electrodermal activity and accelerometry biosensor," *Epilepsia*, vol. 53, no. 5, pp. 93-97, 2012.
- [8] F. Masse, J. Penders, A. Serateyn, M. van Bussel, and J. Arends, "Miniaturized wireless ECG-monitor for real-time detection of epileptic seizures," in *Wireless Health 2010*, ser. WH '10. New York, NY, USA: ACM, 2010, pp. 111-117. Full Text:
- [9] G. de Bruijne, P. Sommen, and R. Aarts, "Detection of epileptic seizures through audio classification," in *4th European Congress of the International Federation for Medical and Biological Engineering (IFMBE)*, 2008.

AUTHORS

First Author – M. Anil kumar, Student, ECE, B.V.Raju institute of technology, Medak, Telangana, India.

Second Author – S. Kishore, Student, ECE, B.V.Raju institute of technology, Medak, Telangana, India.

Third Author – N. Karthik, Student, ECE, B.V.Raju institute of technology, Medak, Telangana, India.

Fourth Author – K. Chandra sekhar, Student, ECE, B.V.Raju institute of technology, Medak, Telangana, India.

Fifth Author – Shaik Shafi, Faculty, ECE, B.V.Raju institute of technology, Medak, Telangana, India.

Sixth Author – M.C.Chinnaiah, Faculty, ECE, B.V.Raju institute of technology, Medak, Telangana, India.

The Linkage between Career Growth, Work Engagement and Organizational Citizenship Behavior: An Insight

Farhana Hanim Mohsin

Universiti Tunku Abdul Rahman

Abstract- Over the last decade until recent years, work engagement has captured a lot of interest among many; academician, industry, consultancy and the like for its positive impact towards work attitudes. To add compendium knowledge on the area, a lot of previous studies have made attempt to conduct work engagement studies on numerous work variables and also in different settings. Despite numerous studies, only few studies have made attempt to posit work engagement as a mediator role. Moreover, with the growing concern on the increasingly crucial aspects of work variables; career growth and organizational citizenship behavior, little is known on how work engagement can propose linkage between the two. In this article, I review sets of literature to propose possible linkage on such relationship. To offer explanatory device, I review and discuss related theories and concepts to provide direction and sense of the possible linkage.

I. INTRODUCTION

Often we heard that for the organization to best success in the home market, one has to start by engaging its employees. Employee engagement measured the extent to which an organization had captured the “hearts and minds” of its people to build and sustain strong business performance. Due to this, it is crucial for the organizations to identify and further explore engagement related issues in order for them to be attentive to the employees’ vigor, dedication and absorption.

Previous studies have shown that career growth can help one’s achieve the career success. Vazirani (2007) highlighted that not only career development will help to promote work engagement among employees and help employee retention, but it also open for them the opportunity to personal development. While a study by Ken Blanchard Companies (2009) stressed career growth must be presented if organization wishes for employee passion to take place and give maximum impact. However, their study found that this factor (career growth) is the least presented in the many companies. It shows that organizations have not given sufficient attention on employees’ career growth and how this career growth effort can generally exhibit positive behaviors (work engagement) at work. A study by Automobile Association of America (AAA) linked engagement with company financial and human resource metrics, such as having individual development plans in place and opportunities for career advancement (Attridge, 2009). Career growth, as in my view, has actually captured the future-minded of employees in which they will decide whether or not they will have a bright future with their current organization. Employees as we knew, tend to be more likely to show their loyalty towards

their individual development rather than any particular organization. The quality of this development process significantly determines the nature and quality of individuals’ lives and the kind of people they become (career growth), the sense of purpose they have (work engagement), the income at their disposal and it also determines the social and economic contribution (OCB) they make to the communities and societies of which that they are part of (Watts, 2009). This more or less, has illustrate to us how actually career growth can impact people lives in the sense of socially contribute to individual and organization as a whole, hence to perform organizational citizenship behavior (OCB).

To understand the issues that arising from OCB, let us first look at the concept of OCB in which its concept has brought about a big change in the field of organizational behavior (Ebrahimpour, Khaleghkhah & Sepehri, 2011). OCB is now considered as fifth bottom line variable in organization behavior research and practice (Singh & Singh, 2010). As Polat (2009) pointed out, OCB increases the ability of attracting and using the workforce of the organization by generating favorable feelings at work towards their organizations. As Najari, Ahmadi and Habibatbar (2011) have mentioned, organizations could not survive or prosper without their members behaving as good citizens by engaging in all sorts of positive organization-relevant behavior. They further noted that OCBs are thought to have an important impact on the effectiveness and efficiency of work teams and organizations, therefore contributing to the overall productivity of the organization. Definitely, most organizations expected that their employees to behave in certain ways that can benefits the company and the people within it. This may helps to develop a positive workplace atmosphere and motivated everyone to bring about change in working more effectively and efficiently. OCB should be encouraged more among people to put in practice, and not just another management cliché. However, to date, there is no definite answer to OCB yet, as what it is composed, what really caused it, and what are the absolute consequences from it.

This work hopes to contribute to work engagement literature generally by posing it as mediating role of the relationship between career growth and OCB. In doing so, the underlying theory of Social Exchange Theory (SET), Job Demand-Resources (JD-R) Model and Conservation of Resources (CoR) Theory aimed to provide an extensive explanation of such relationships.

II. LITERATURE REVIEW

CAREER GROWTH AND WORK ENGAGEMENT

Following the work from Weng and McElroy (2012), career growth is referred to as organizational career growth to reflect the fact that it refers to one's career growth within one's current organization, rather than one's assessment of their career growth over their total career in the workforce. According to them, career growth could be captured by three factors: that are (1) *Career goal progress* or the degree to which one's present job is relevant to and provides opportunities for one to realize their career goals; (2) *Professional ability* development, or the extent to which one's present job enables them to acquire new skills and knowledge; (3) *Organizational rewards* are being measured using (a) promotion speed, an employee's perceptions of the rate and probability of being promoted; and (b) remuneration growth, or employee perceptions of the speed, amount, and likelihood of increases in compensation (pg 257).

As defined by Weer (2006), career growth can help individual workers to enhance their career advancement in organization if the organization gives opportunities such as by being offered responsibilities, challenging assignments, and learning opportunities. This may help individual worker to gain new skills and knowledge as they worked on work assignments.

Leadership Insight, (2010) the talent and career management expert, in their research found that organizations that provide career development opportunities are six times more likely to engage their employees than organizations that do not. In detail, from their report, at 63%, Canada, the United States and Denmark showed the highest engagement levels among employees who agreed or strongly agreed that their organizations provide career opportunities. The study further suggests that not only it is consider as an essential step to facilitate career discussion in order to empower employees to drive their own development and to provide career development for them, but it will also help managers to address the top engagement drivers among individual. This basically portray that organizations that provide opportunities to develop in career and gaining new knowledge and skills can help to promote high engagement level among employees .

Hulkko-Nyman et al. (2012) have highlighted that since total organizational rewards can be categorized as monetary (remuneration) and non-monetary (promotional) rewards, both should be appealing to employees because individual needs can more flexibly be met with total rewards' practices. According to Bakker and Demerouti (2007), pay (remuneration) and career opportunities (promotional) can be considered as job resources that being provided at the organization level and these resources are considered as antecedents for work engagement.

Coetzee and Villiers (2010), suggest individuals are making a choice that are related to their career self-development, individual may become more aware about the values and motive (goals) of career decision they make. Employees' intrinsic motivation (work engagement) can be improved if they perceived that their career goal can be realized by serving their current organization.

According to study done by Thiagararan (2011), all the factors of employee engagement practices (example responsibility at work, motivation, performance appraisal, and competency) are positively correlated with career development. The study conclude that even though it is not possible to expect fully engagement among employees, the organization can still encourage employee to have active participation in their job by means of proper guidance (in job, career development, performance appraisal, motivation and competency).

On the basis of JDR model, career growth can be posed as job resources, providing the definition of job resources itself, as those physical, psychological, social or organizational aspects of a job that either/or reduce job demands and the associated physiological and psychological costs, are functional in achieving work goals and stimulate personal growth, learning and development (Schaufeli & Bakker, 2004).

ORGANIZATIONAL CITIZENSHIP BEHAVIOR AND WORK ENGAGEMENT

Organizations that are excellent are generally and constantly putting forth efforts to improve positive organizational outcomes by maintaining highly motivated employees and to promote and encourage positive voluntary behavior such as OCB (Abuiyada & Chou, 2012). OCB according to Ariani (2013, pg 46) is individual behavior that is discretionary, not directly and explicitly recognized by the formal reward system and also promotes the efficient and affective functioning of the organization as well as employee performance.

To relate OCB with work engagement, the work form Ahmed, Rasheed & Jehanzeb (2011) stressed that work engagement may leads to OCB as it focuses on other positive outcomes at work which are voluntary and lies outside the given parameters of any organization. They further suggest that the more employees are engaged with their work, the more likely they are to displayed and performed OCB. Similarly, as found by Mansoor, Aslam, Javad, Ashraf & Shabbir (2012), the more actively an employee is engaged in his or her work, the higher likelihood for them to exhibit citizenship behavior.

Now that there are gaining efforts and research in work engagement field, researchers are also interested to study the outcomes of work engagement toward specific OCB (Matamala, 2011). Williams and Anderson (1991) in their findings have highlighted that OCB can be categorized into two dimensions in which OCB directed towards individual (OCBI) and OCB directed towards organization (OCBO). OCBI is behaviors that can be beneficial to particular individuals (employees) and through this, it indirectly contribute to the organization (i.e. helps others who have been absent, takes a personal interest in other employees), and OCBO – behaviors that beneficial to the organization as in general (i.e. gives advance notice when unable to come to work, adheres to informal rules devised to maintain order) (Huang & You, 2011).

Following the suggestion from Williams and Anderson (1991), this study is designed to highlight the dimensions of OCB; that is OCBO rather than OCBI and to examine how OCBO is the outcome of work engagement. Mohammad, Habib and Alias (2011) noted that OCBO is more likely to be the outcome of work engagement as the employees perceived that

they are obligated to balance social exchange towards the organization that they serve since organization has provided them with desirable job resources (career growth) and it seems like employees who perform OCB are expected to have higher level of job motivation (work engagement).

THE MEDIATING ROLE OF WORK ENGAGEMENT AS INTRINSIC MOTIVATION

In the current study, I perceive work engagement as an indicator of intrinsic motivation at work. To identify such engaged employees, their characteristic can be shown by the readiness and willingness to direct personal energies into physical, cognitive, and emotional expressions associated with fulfilling required and discretionary work roles (Thomas, 2007). Similarly, as mentioned by Seijts and Crim (2006), an engaged employee is a person who is fully involved in, and enthusiastic about, his or her work.

To explain the concept of work engagement as intrinsic motivation in association with motivation theory, Social Exchange Theory (SET) is widely used among researchers. The central tenet of SET is that people make social decisions based on perceived costs and benefits (Cropanzano and Mitchell, 2005). According to Saks (2006), a good way for employees to repay their organization is through their level of engagement. Employees will choose whether or not to engage themselves in relation to the resources (i.e career growth) they get from their organization. Employee engagement involves emotional and psychological relationship between employees and their organization that can be transmuted into negative or positive behaviors which employees display at their workplace (Andrew and Sofian, 2012). In my view, these negative or positive behaviors as in the current study could be perceived as OCB. This can be supported by a study from Lin, Cheng and Wu (2004) in which they mentioned that SET views interpersonal interactions from a cost benefits perspective, much akin to an economic exchange, excepts that a social exchange deals with the exchange of intangible social costs and benefits (such as respect, honor, friendship, and

To understand the mediating role better, here I also adapted Job Demand-Resources Model (JD-R) to look into how this mediating effect of work engagement is possible. The JD-R model can be the basis model to predict employee well-being, work engagement and burnout, since its application can be used to assess regardless what type of job (De Brained & Roodt, 2011). As mentioned above, in the motivational process, as mentioned by Hakanen, Schaufeli and Ahola (2008), job resources also can influence employee well being by motivating them internally since job resources are assumed to increase work engagement which, in turn, is associated with positive outcomes, (i.e. OCB). They further noted that this is possible through the fostering of employee growth, learning and development, or by helping employees to achieve their goals. According to Bakker and Demerouti (2007, pg 312), job resources may be located at the level of the organization at large (e.g. pay, career opportunities, job security), the interpersonal and social relations (e.g. supervisor and co-worker support, team climate), the organization of work (e.g. role clarity, participation in decision making), and at the level of the task (e.g. skill variety, task

identity, task significance, autonomy, performance feedback). This in my view, shows to us that career growth as job resources is considered at the organizational level, in which the ones provided by the organizations to employees. Having to received much from the organizations in term of career benefits (i.e. career goals, professional ability, organizational rewards), in turn, employees are likely to display a positive work outcomes, by performing OCB.

Another condition for this intrinsic motivation of work engagement to take effect is that, the benefits/resources that employees received from the organization must be something that they truly valued. Having to say this, here I also adapted the Conservation of Resources (COR) Theory as the basis of my assumption. This theory is a relevant theory for us to understand how career growth as job resources are something that employees valued and worked for, and they would do just about anything to protect whatever things that they perceived as valuable. As Hobfoll (2001) highlighted, COR theory is basis on assumptions that people would strive to protect and retain (by engaging in OCB) what they value (career growth). He further noted that the things that individual values are called as resources, in which are not individually determined.

III. CONCEPTUAL FRAMEWORK



Figure 1: Conceptual Framework

IV. CONCLUSION

On the whole, this study provides insight on the relationships between career growth, work engagement and organizational citizenship behavior (OCB). Based on the presented previous studies and literatures on work engagement, career growth and OCB, it is clear to us that the relationships of all the mentioned areas of studies are still lacking in term of widely agreed concepts. Currently, work engagement is being studied in different perspectives, in which no longer being posited as positive aspect of employee well being. A lot of researchers are now looking into its negative perspectives. This might be interesting though, however positive side of work engagement is still in need for better findings and extensive literature. Thus, there is more to learn about this concept and work engagement literature will need to be extended and calling for more researches in future are necessary which looking at the concept in different perspectives, conditions, settings, etc to form a solid foundation of such area. In the end, I hope to that this study will helps in term of providing wider insight in work engagement scope. According to Bakker et al. (2008), a focus on employee engagement may not only be beneficial to individual worker, but can also become as source of competitive advantage for the

companies. HRD practitioners also are in need to understand and provide a useful guidance for work engagement; and to be doing just that, research must provide theoretically supported constructs for how this concept can be measured, fostered, and related to organizational outcomes (Zigarmi et al., 2009).

REFERENCES

- [1] Abuiyada, H. S., & Chou, S. Y. (2012). A Two-Factor Model of Organizational Citizenship Behaviour in Organizations. *European Journal of Business and Management*, 4(3), 134-144.
- [2] Ahmed, N., Rasheed, A., & Jehanzeb, K. (2012). An Exploration of Predictors of Organizational Citizenship Behaviour and its Significant Link to Employee Engagement. *International Journal of Business, Humanities and Technology*, 2(4),99-106.
- [3] Andrew, O. C., & Sofian, S. (2012). Individual Factors and Work Outcomes of Employee Engagement. *Procedia - Social and Behavioral Sciences*, 40, 498-508.
- [4] Bakker, A.B., et.al. (2008). *Work Engagement: An Emerging Concept in Occupational Health Psychology*. Routledge. 187-199.
- [5] Bakker, A. B., & Demerouti, E. (2007). The Job Demands-Resources model: state of the art.
- [6] De Braine, R., & Roodt, G. (2011). The Job Demands-Resources model as predictor of work identity and work engagement: A comparative analysis. *SA Journal of Industrial Psychology*, 37(2), 1–11.
- [7] Coetzee, M. & Villiers, M. D. (2010). Sources of Job Stress, Work Engagement And Career Orientations Of Employees In A South African Financial Institution. *Southern African, Business Review*. 27. 57.
- [8] Cropanzano, R., & Mitchell, M. S. (2005). Social Exchange Theory: An Interdisciplinary Review. *Journal of Management*. 31. 874-900.
- [9] Ebrahimpour, H., Zahed, A., Khaleghkhah, A., & Sepehri, M. B. (2011). A Survey Relation Between Organizational Culture And Organizational Citizenship Behavior. *Social and Behavioral Sciences*, 30, 1920 – 1925.
- [10] Hakanen, J. J., Schaufeli, W. B., & Ahola, K. (2008). The Job Demands-Resources model: A three-year cross-lagged study of burnout, depression, commitment, and work engagement. *Work & Stress*, 22(3), 224–241.
- [11] Hobfoll, S. E. (2001). The Influence of Culture, Community, and the Nested-Self in the Stress Process: Advancing Conservation of Resources Theory. *Applied Psychology*, 50(3), 337–421.
- [12] Huang, C., & You, C. (2011). The Three Components of Organizational Commitment on In- Role Behaviors and Organizational Citizenship Behaviors. *African Journal of Business Management*, 5(28), 11335-11344.
- [13] Hulkko-Nyman, K., et al. (2012). Total Rewards Perceptions and Work Engagement in Elder-Care Organizations. *International Studies of Management and Organization*. 42(1). 24-49.
- [14] Ken Blanchard Companies (2009). *From Engagement to Work Passion*. The Ken Blanchard Companies. 1-12.
- [15] Leadership Insight (2010). *Advancing Careers, Driving Results: Career Development for Business Success*. Right Management. 1-22.
- [16] Lin, T., Cheng, H. K., & Wu, S. (2004). To Share or Not to Share: A Social Exchange Theory Perspective of Virtual Team Members' Behavior. *Proceedings of the Second Workshop on Knowledge Economy and Electronic Commerce*, 317-329.
- [17] Mansoor, N., Aslam, H. D., Javad, T., Ashraf, F., & Shabbir, F. (2012). Exploring Organizational Citizenship Behavior and its Critical Link to Employee Engagement for Effectual Human Resource Management in Organizations. *Mediterranean Journal of Social Sciences*, 3(1), 567-576.
- [18] Matamala, A. (2011). *Work Engagement as a Mediator Between Personality and Citizenship Behavior*. FIU Electronic Theses and Dissertations, 1-89.
- [19] Mohammad, J., Habib, F. Q., & Alias, M. A. (2011). Job Satisfaction and Organizational Citizenship Behavior: An Empirical Study at Higher Learning Institution. *Asian Academy of Management Journal*, 16(2), 149-165.
- [20] Najari, R., Ahmadi, F., & Habibitabar, Z. (2011). Study of Relationship Between Personality and Organizational Citizenship Behavior (OCB) in Public Organizations in Iran, *Interdisciplinary Journal of Contemporary Research in Business*, 3(2), 472-483.
- [21] Polat, S. (2009). Organizational Citizenship Behavior (OCB) Display Levels Of The Teachers At Secondary Schools According to the Perceptions Of The School Administrators. *Procedia Social and Behavioral Sciences*, 1, 1591–1596.
- [22] Saks, A. M. (2006). Antecedents and Consequences of Employee Engagement. *Journal of Managerial Psychology*, 21(7), 600-619.
- [23] Schaufeli, W.B., Bakker, A.B. & Salanova, M. (2006). The Measurement of Work Engagement With a Short Questionnaire: A Cross-National Study. *Educational and Psychological Measurement*. 701-716.
- [24] Seijts, G.H. & Crim, D. (2006). What Engages Employees the Most or, The Ten C's of Employee Engagement. *Ivey Business Journal Online*. 1-5.
- [25] Shahzad, K. et.al (2011). Organizational Environment, Job Satisfaction and Career Growth Opportunities: A Link to Employee Turnover Intentions in Public Sector of Pakistan. *Interdisciplinary Journal of Contemporary Research in Business*. 45-56.
- [26] Singh, A. K., & Singh, A. P. (2010). Career Stage and Organizational Citizenship Behaviour among Indian Managers. *Journal of the Indian Academy of Applied Psychology*, 36(2), 268-275.
- [27] The Star Online. (2011, March 2). "Firms must engage more with employees". The Star Online. Retrieved December 10, 2011 from <http://biz.thestar.com.my/news/story.asp?file=/2011/3/2/business/8165260&sec=business>.
- [28] Thiagaran, B. (2011). Employee Engagement Practices In Indian BPO Industries: An Empirical Investigation. *Interdisciplinary Journal of Contemporary Research in Business*. 1-9.
- [29] Thomas, C.H. (2007). *A New Measurement Scale For Employee Engagement: Scale Development, Pilot Test, And Replication*. Northern Illinois University.
- [30] Vazirani, N. (2007). Employee Engagement. *SIES College of Management Studies*. 1-17.
- [31] Weer, C.H. (2006). The Impact of Non-Work Role Commitment on Employees' Career Growth Prospects. *Drexel University*. 1-217.
- [32] Weng, Q. 和 M. J. (2012). Organizational Career Growth, Affective Occupational Commitment and Turnover Intentions. *Journal of Vocational Behavior*, 80(2), 256–265.
- [33] Zigarmi, D. et.al., (2009). Beyond Engagement:Toward a Framework and Operational Definition for Employee Work Passion. *Human Resource Development Review*. 301-326

AUTHORS

Author – Farhana Hanim Mohsin, Universiti Tunku Abdul Rahman, farhanam@utar.edu.my

Detect and Prevent the Mobile Malware

Abdullah Mohammed Rashid & Ali Taha Al-Oqaily

College of IT, University Tenaga Nasional Kajang, Selangor, Malaysia

Abstract- Mobile devices such as mobile phones have become one of the most needed and important device for everyone living in the 21st century. This is due to their ability in accommodating people with information and effective communication that make people's life easier and more meaningful. However, the conveniences offered by the devices come with security concern: mobile malware. There are many incidents caused by mobile malware that downgrade organization's reputation or financial lost. The mobile malware represent a security threats to mobile devices, there are many types of mobile malware compromising the security platform. This paper discusses techniques to effectively detect and prevent the mobile malware and propose an improvement towards current techniques which gives better mobile malware detection and prevention.

Index Terms- Malware; mobile Malware; Detection and Prevent.

I. INTRODUCTION

Mobile devices have become one of the most important needs in the 21st century living era [17 & 9]. This is shown, for example, when many organizations started to convert their computing resources such as Personal Computer (PC) to mobile phones due to many convenient features offered by mobile phones; lighter, excellent connectivity to Wi-Fi, portable and accessible anywhere. According to C Laudon in THIRTEENTH EDITION the General Electric (GE) is one of the world largest companies, producing aircraft engines and other transportation purely convert to use the I phone device to perform the employees activities such report and data analysis . Nowadays, mobile computing is adopted in many purposes such as keep contact numbers, data storage, transaction process, internet access and checking the emails [4]. According to the Ericsson report, there are around 6.7 billion mobile subscriptions at the moment and, approximately 9.3 billion mobile subscriptions at the end of 2019 [22].

One of the security threats over the use of mobile devices is SMS fraud which is a common threat in Android, IOS and Apple. It works like this: the users receive a message asking them to subscribe in daily, weekly or monthly service. The users usually have tendency to subscribe by providing personal information such as credit card number because the service is initially made as a free of charge. After several period, the service begins to charge the users without their knowledge [6 & 22]. Another type of security threats is Spyware, which steals data from the mobile device without user's permission [7].

One way to prevent the mobile devices from these threats (malware), users need to use antimalware tools. These tools identify, attract and catch the known malware and notify the users of further action to be taken. However, some of the new

malware cannot be recognized by normal software or tools an improvement on the detection technique is required.

Mobile malware threat is a real challenge in mobile devices [12 & 10]. This threat is exacerbated with the increasing number of mobile devices accessing to the internet as a basic and daily service. Some of the malwares are harmful to the mobile devices in many ways, such as exhausting the battery use, destructing files and fraudulently send SMS or email to the contacts without the knowledge of the mobile device owner [22 & 14].

The main objective of this study is to discuss several techniques that can be used to detect and prevent mobile malwares from attacking mobile devices. Then, the comparisons between various techniques are given and that leads towards our recommendations to improve the current detection and prevent techniques.

II. RELATED WORKS

A. Related Methods of Mobile Malware Detection

Many researchers use various methods and software to detect , attack and prevent mobile malware. The table below reviews some of these methods, which are described in details in Related Works section.

No.	Methods	Description
<u>1</u>	ESET	An antivirus application used to detect and prevent mobile malware.
<u>2</u>	F-Secure	An antivirus application used to detect and prevent mobile malware.
<u>3</u>	Kasper sky	An antivirus application used to detect and prevent mobile malware.
<u>4</u>	McAfee	An antivirus application used to detect and prevent mobile malware.
<u>5</u>	Norton	An antivirus application used to detect and prevent mobile malware.
<u>6</u>	Trend Micro	An antivirus application used to detect and prevent mobile malware.
<u>7</u>	Pre Crime	A proactive defensive approach produced by Haibo Li et al. (2014) that use mirror synchronization to delay system events and speculate user events for detecting mobile malware.
<u>8</u>	Dynamic analysis	Collecting data related to calls and analysis the collected data in different tools.
<u>9</u>	Static analysis	Collecting data related to the names of the functions and calls appearing at the output; collecting the next responses, then follows certain mechanisms for

		analysis.
<u>10</u>	Cloud service	Used to predict the next event of a mobile or maintain a copy from the mobile event.
<u>11</u>	Monitoring	Key the eyes within mobile to monitor many things such as power expenditure.

B. Existing Techniques

Previous researchers have proposed a number of models, methods, and mechanisms to detect and prevent malware in mobile devices [2 & 18]. Most of these methods are summarized as static analysis, dynamic analysis, cloud computing, and signature-based. First, antivirus application system is a traditional technique that uses signature-based approach to detect malware such as ESET, F-Secure, Kasper sky, McAfee, Norton, and Trend Micro [12].

In terms of cloud service [18 & 15] used cloud as a service to detect and prevent mobile malware. [18] produced the Pre Crime proactive malware detection system that is employed to predict the behavior of mobile devices and compare with the next event to ensure that the next event is normal or abnormal.[15] used cloud infrastructure to perform complex analysis methods in order to detect malware families by periodically updating the database for detection.

Another methods used by [12 ; 7 & 17] placed several steps to detect and prevent mobile malware. [12] used the method of monitoring power consumption, increasing platform diversity and enforcing hardware and box; [7] used antivirus application to be aware of battery and network, checking device setting and downloading applications from trusted providers; [17] developed a protective model from five stages to detect and prevent mobile malware, which are caution, investigate, monitor, update and remove.

Vast number of researchers focused on static analysis, dynamic analysis or both of them [13; 16 & 11] . Aubrey-Derrick Schmidt collected the names of the functions and calls appearing at the output and next responses, and then follows certain mechanisms for analysis; [16] developed a framework which uses only dynamic analysis to detect malware in the Android platform; [11] is a combination of static analysis and dynamic analysis, in which the static analysis detects malicious code and the dynamic analysis identifies malicious packet structure.

Finally, [8] used only the monitoring method to detect mobile malware by observing the electric power of the mobile device and energy consumption history, since mobile malware open channels, such as Wi-Fi and Bluetooth consume mobile power. Also [3 & 5] monitored and detected malicious malware by observing power consumption.

In conclusion, researchers used four methods to detect and prevent mobile malware, which are cloud service, model-based stage, static and dynamic analysis and power consumption observation.

C. Mobile Malware Behaviors

There are many malwares that attack mobile devices such as SMS Zombie, Worm, and Spyware. The most popular and malicious malware is Trojan. Trojan malware infects mobile devices through separate malicious mobile applications, free apps

or purchased from non-authentic resource, p2p file sharing, download from website or e-mail distribution. This kind of malware can : (1) Collect private data from current mobile device or install other malicious apps like worms. (2) Send SMS to contact numbers in the infected mobile device. (3) Trojans can be used to commit phishing activities. This situation disrupts the financial for banking companies, organizations and individual users, for example financial loss to the sender and receiver, sender is charged for sending SMS, and receiver receives SMS that tells them to subscribe daily or monthly service [20 ;19 & 21].

III. DISCUSSION

From the result of the previous review, the cloud used in the PreCrime scheme keeps the mobile performance stable as it predicts run in the cloud. However, this method can only detect malware but cannot prevent the malware [18]. Also, the cloud infrastructure is used for complex analysis and detecting malware families, reducing storage space usage and reducing complex processing [1]. This method requires standard access to the Internet, consumes mobile battery, and not precise in detecting the malware alone [1 & 15].

Using the steps to detects and prevents malware is time consuming because it requires periodical monitoring, checking and changing or updating the mobile operating system.

Static analysis is fast and easy to detect malware but it cannot catch malicious malware that uses blackout, where as dynamic analysis can detect the malware even with blackout, but consumes storage capacity [1].

Montoring mobile battery consumption can detect malware, but the major challenges for this monitoring method are that it identifies more technical details and consumes mobile storage due to storage of power history [8].

IV. RECOMMENDATION

Dynamic analysis can detect and prevent malware, but this method consumes storage space. On the other hand, the Pre Crime cloud service scheme can detect malware but cannot prevent malware and keep efficient mobile performance.

The integration between the dynamic analysis method and the Pre Crime cloud service scheme could be proposed as an efficient solution of both methods weaknesses. The result of dynamic analysis storage in cloud space solves the storage challenge in dynamic analysis and uses cloud to predict the mobile behavior, as compared to the dynamic analysis result. The proposed method can detect, prevent ,and provide storage space to dynamic analysis and use the cloud service.

V. CONCLUSION

As long as technology continues to develop mobile malware are also developed continuously in line with new technology. Users are affected through the development of malware, for that measures need to be developed early before new malware emerges. The main contribution of the proposed solution is to produce a new model, method and technique to

detect and prevent malware through a combination of cloud service and dynamic analysis.

REFERENCES

- [1] Mohd Zaki Mas`ud, Shahrin Sahib, , Mohd Faizal Abdollah, Siti Rahayu Selamat and Robiah Yusof, 2014. Android Malware Detection System Classification. *Research Journal of Information Technology*, 6: 325-341.
- [2] Rastogi, V., Chen, Y., & Enck, W. (2013, February). Appsplayground: automatic security analysis of smart phone applications. In *Proceedings of the third ACM conference on Data and application security and privacy* (pp. 209-220). ACM.
- [3] Kim, H., Smith, J., Shin, K.G.: Detecting energy- greedy anomalies and mobile malware variants. In: *Proceeding of the 6th international conference on Mobile systems, applications, and services*, pp. 239–252 (2008)
- [4] Pousttchi, K., Weizmann, M., & Turowski, K. (2003). Added value-based approach to analyze electronic commerce and mobile commerce business models.
- [5] Liu, L., Yan, G., Zhang, X., Chen, S.: Virusmeter: Preventing your cellphone from spies. In: *Proceedings of the 12th International Symposium On Recent Advances In*
- [6] Mikko Hypponen. Malware goes mobile. Nov. 2006
- [7] Mu, J., Cui, A., & Rao, J. (2013, July). Android Mobile Security–Threats and Protection. In *International Conference on Computer, Networks and Communication Engineering (ICCNCE 2013)*. Atlantis Press.
- [8] Ghallali, M., El Ouadghiri, D., Essaaidi, M., & Boulmalf, M. (2011, December). Mobile phones security: the spread of malware via MMS and Bluetooth, prevention methods. In *Proceedings of the 9th International Conference on Advances in Mobile Computing and Multimedia* (pp. 256-259). ACM.
- [9] Nadji, Y., Giffin, J., & Traynor, P. (2011, December). Automated remote repair for mobile malware. In *Proceedings of the 27th Annual Computer Security Applications Conference* (pp. 413-422). ACM.
- [10] Mu, J., Cui, A., & Rao, J. (2013, July). Android Mobile Security–Threats and Protection. In *International Conference on Computer, Networks and Communication Engineering (ICCNCE 2013)*. Atlantis Press.
- [11] Malhotra, A., & Singh, P. P. (2014). Android Malware: Study and Analysis for Privacy Leak in Ad-Hoc Network. *IJCSNS*, 14(6), 92.
- [12] Yan, Q., Li, Y., Li, T., & Deng, R. (2009). Insights into malware detection and prevention on mobile phones. In *Security Technology* (pp. 242-249). Springer Berlin Heidelberg.
- [13] Schmidt, A. D., Bye, R., Schmidt, H. G., Clausen, J., Kiraz, O., Yuksel, K. A., ... & Albayrak, S. (2009, June). Static analysis of executables for collaborative malware detection on android. In *Communications, 2009. ICC'09. IEEE International Conference on* (pp. 1-5). IEEE.
- [14] Felt, A. P., Finifter, M., Chin, E., Hanna, S., & Wagner, D. (2011, October). A survey of mobile malware in the wild. In *Proceedings of the 1st ACM workshop on Security and privacy in smartphones and mobile devices* (pp. 3-14). ACM.
- [15] Milosevic, J., Dittrich, A., Ferrante, A., & Malek, M. (2014, September). A Resource-optimized Approach to Efficient Early Detection of Mobile Malware. In *Availability, Reliability and Security (ARES), 2014 Ninth International Conference on* (pp. 333-340). IEEE.
- [16] Burguera, I., Zurutuza, U., & Nadjm-Tehrani, S. (2011, October). Crowdroid: behavior-based malware detection system for android. In *Proceedings of the 1st ACM workshop on Security and privacy in smartphones and mobile devices* (pp. 15-26). ACM.
- [17] Pieterse, H., & Olivier, M. S. (2013, August). Security steps for smartphone users. In *Information Security for South Africa, 2013* (pp. 1-6). IEEE.
- [18] Tan, C., Li, H., Xia, Y., Zang, B., Chu, C. K., & Li, T. (2014, June). PreCrime to the rescue: defeating mobile malware one-step ahead. In *Proceedings of 5th Asia-Pacific Workshop on Systems* (p. 5). ACM.
- [19] Dunham, K. (2008). Mobile malware attacks and defense. Syngress.
- [20] Delac, G., Silic, M., & Krolo, J. (2011, May). Emerging security threats for mobile platforms. In *MIPRO, 2011 Proceedings of the 34th International Convention* (pp. 1468-1473). IEEE.
- [21] Fleizach, C., Liljenstam, M., Johansson, P., Voelker, G. M., & Mehes, A. (2007, November). Can you infect me now?: malware propagation in mobile phone networks. In *Proceedings of the 2007 ACM workshop on Recurring malcode* (pp. 61-68). ACM.
- [22] (2013, November). [Online]. available: <http://www.ericsson.com/res/docs/2013/ericsson-mobility-report-november-2013.pdf>

AUTHORS

First Author – Abdullah Mohammed Rashid, College of IT, University Tenaga Nasional Kajang, Selangor, Malaysia, Email: abdalla_rshd@yahoo.com, ST21977@utn.edu.my
Second Author – Ali Taha Al-Oqaily, College of IT, University Tenaga Nasional Kajang, Selangor, Malaysia, Email: Oqli83@yahoo.com

Eco-Friendly Management of Pulse Beetle, *Callosobruchus chinensis* Linn. Using Fumigants on Stored Mungbean

Md. Zahid Khan, Md. Razzab Ali, Md. Serajul Islam Bhuiyan and Md. Awlad Hossain

Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh

Abstract- The experiment was conducted in the laboratory under the Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from April to July, 2011 to find out the eco-friendly management of pulse beetle, *Callosobruchus chinensis* Linn. on stored mungbean using some promising fumigants viz. Camphor @ 1.0 g /kg mungbean grains (T₁), Phostoxin tablet @ 200 mg /kg mungbean grains (T₂) and Naphthalene @ 500 mg /kg mungbean grains (T₃) and control (T₄). The experiment was laid out in Completely Randomized Design with four replications. From this study, it was observed that the treatment T₁ comprised with Camphor @ 1.0 g /kg mungbean grains reduced the highest percent of grain infestation by number and weight (49.65% & 49.54%, respectively) over control than other fumigants. Conversely, T₁ reduced the highest percent of adult emergence (77.66%) and grain content loss (95.18%) over control, but increased the highest percent of seed germination (26.57%) over control. Therefore, it can be concluded that Camphor @ 1.0 g/kg mungbean grains was the most effective control measure applied against pulse beetle, *C. chinensis* on stored mungbean.

Index Terms- *Callosobruchus chinensis* Linn., eco-friendly management, fumigants.

I. INTRODUCTION

Pulses serve as one of the main sources of protein and minerals as well as play a vital socio-economic role in the diet of common people of Bangladesh. Among pulses, mungbean, *Vigna radiata* Linn. Wileazek has come up an important pulse crop in Bangladesh. It contains 51% carbohydrate, 26% protein, 4% minerals, 3% vitamins (Yadav *et al.*, 1994). Its sprout is a high quality vegetable and rich in vitamin-C and iron. Mungbean plant fixes atmospheric nitrogen in symbiosis with soil bacteria to enrich soil fertility as well as it provides useful fodder (Afzal *et al.*, 2004). The traders mostly store the pulses at least for few months before they sell it. Unfortunately, in storage, pulses suffer enormous losses due to bruchid attack, which infestation starts either in the field on the maturing pod and is carried to the stores with the harvested crops or it originates in the storage itself (Fletcher and Ghosh, 2002). Three species of pulse beetles, viz., *Callosobruchus chinensis* Linn., *C. analis* Fab., and *C. maculatus* Fab. have been reported from Bangladesh as the pests of stored pulses (Begum *et al.*, 1984; Rahman *et al.*, 1981 and Alam, 1971). However, Alam (1971) reported that *Callosobruchus chinensis* to cause enormous

losses to almost all kind of pulses in storage condition. Rahman (1971) reported 12.5% loss due to pulse beetles infestation in pulses stored in warehouses. Ali *et al.* (1999) reported that mungbean, *Vigna radiata* appeared to be the most common and suitable host for *C. chinensis* in respect of oviposition, egg deposition, adult emergence (66.11-70.29%) and caused 50.37 - 57.58% grain content loss in storage. Synthetic chemicals have become a common practice among the farmers and stockholders to control the storage pests of pulses (Dilwari *et al.*, 1991; Chandra *et al.*, 1989; Singh *et al.*, 1989; Prakash and Rao, 1983; Yadav, 1983). It is now widely known that the chemical method has several problems, which include health hazards to the users and grain consumers. It causes residual toxicity, environmental pollution and development of pesticide resistance against bruchids (Srivastava, 1980). Hence, search for the alternative method of pulse beetle control utilizing some non-toxic, environment friendly and human health hazard free methods are being pursued such as fumigants. In Bangladesh Camphor (C₁₀H₁₆O) that extracted from the leaves and wood of Camphor tree (*Cinamomum camphora*). Chauvin *et al.* (1994) reported that camphor has fumigation properties and has got a very low mammalian toxicity. Rahman *et al.*, (2001) reported the fumigation action of camphor against pulse beetle, *C. chinensis*. Miah (2007) reported that camphor @ 2 gm/kg seeds performed the best results in respect of percent reduction (100%) of larvae and pupae, grain infestation and grain content loss over control for both *C. chinensis*. In Bangladesh, very little study has so far been reported on the efficacy of camphor against pulse beetles. Another fumigant, the phostoxin is available in the market at its tablet or pellet form. The chemical name phostoxin is aluminium phosphide (Onu and Aliyu, 1995), which is used as a rodenticide, insecticide, and fumigant for stored cereal grains (Mahadi and Hamoudi, 2010). Naphthalene is a household fumigant also, which build up vapors that are toxic to both the adult and larval forms of many insects that attack textiles (Bryn, 2002) and other stored products. In considering hazards free management of *C. chinensis* using fumigants in storage aiming to assess the extent of damage of stored mungbean grains infested by *C. chinensis* as well as determining the efficacy of some fumigants against this insect pest.

II. MATERIALS AND METHODS

The study was conducted to explore the efficacy of fumigants camphor, phostoxin tablet and naphthalene for eco-friendly management of pulse beetle, *Callosobruchus chinensis* L.

stored mungbean grain in the laboratory under the Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period of April, 2011 to July, 2011. The experiment was laid out in the ambient condition of the laboratory considering Completely Randomized Design (CRD) and the experiment was replicated four times for each treatment. Each of three fumigants was treated as an individual treatment. One kg of mungbean grains for each of the treatment was kept in plastic pot covered with lead. Camphor was applied at the rate of 1.0 g /kg mungbean grains, Phostoxin tablet was applied at the rate of 200 mg /kg mungbean grains and Naphthalene was applied at the rate of 500 mg /kg mungbean grains. Besides these fumigants, one untreated control was also considered. The experiment was replicated four times for each of the treatments. The hundred pairs of adult pulse beetle, *C. chinensis* Linn. were released in the mungbean grains kept in all plastic containers, which were then covered with their lids and preserved in ambient temperature of the laboratory up to 120 days after insect release (DAIR) for recording data. The data on grain infestation by number and weight, adult emergence, grain content loss, and seed germinations were recorded. The data were collected and recorded at 20 days intervals started from 20 DAIR and continued up to 120 DAIR. The percent grain infestation and percent reduction of grain infestation over control were then calculated using the following formulae (Khosla, 1997):

$$\% \text{ grain infestation} = \frac{\text{Number of infested grains}}{\text{Number of total grains observed}} \times 100$$

$$\% \text{ reduction of grain infestation over control} = \frac{X_2 - X_1}{X_2} \times 100$$

Where, X_1 = Mean value of treated pot, X_2 = Mean value of untreated pot

III. RESULTS AND DISCUSSION

The study was conducted to find out the efficacy of some promising fumigants viz. camphor, phostoxin tablet and naphthalene for eco-friendly management of pulse beetle, *Callosobruchus chinensis* Linn. infesting mungbean in the laboratory under the Department of Entomology at Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from April, 2011 to July, 2011. The findings of the study have been interpreted and discussed under the following sub-headings:

Effect of fumigants on grain infestation by number

The significant variations were observed among different fumigant based management practices in terms of percent grain infestation by number throughout the storing period starting from 20 to 120 (DAIR) considering 20 days interval during the management of pulse beetle, *C. chinensis* on mungbean. In case of 20 DAIR, the highest grain infestation by number (45.73%) was recorded in T_4 comprised of untreated control, which was statistically different from all other treatments followed by T_3 (31.57%) comprised of naphthalene (Table I). On the other hand, the lowest grain infestation by number (20.29%) was recorded in T_1 . In case of 40 DAIR, the highest grain infestation by number (51.40%) was recorded in T_4 comprised of untreated control, which was statistically different from all other treatments followed by T_3 (32.04%) (Table I). On the other hand, the lowest grain infestation (22.59%) was recorded in T_1 (36.79%) followed by T_2 (28.51%). More or less similar trends of results were also recorded in case of 60, 80, 100 and 120 DAIR in terms of percent grain infestation by number. Considering the mean grain infestation by number, the highest grain infestation (51.81%) was recorded in T_4 , which was statistically different from all other treatments followed by T_3 (34.77%). On the other hand, the lowest grain infestation (26.09%) was recorded in T_1 followed by T_2 (29.47%). In case of grain infestation reduction over control, the highest reduction (49.65%) was recorded in T_1 followed by T_2 (43.13%). On the other hand, the lowest grain infestation reduction (32.89%) was recorded in T_3 .

Table I: Effect of fumigants on the mungbean grain infestation by number against *C. chinensis* during April to July, 2011

Treatments	% Grain infestation by number							%infestation reduction over control
	20 *DAIR	40 DAIR	60 DAIR	80 DAIR	100 DAIR	120 DAIR	Mean	
T_1	20.29d	22.59d	24.63d	29.28c	29.76c	29.98c	26.09d	49.65
T_2	27.80c	28.51c	29.45c	30.17c	30.23c	30.63c	29.47c	43.13
T_3	31.57b	32.04b	33.17b	35.98b	37.12b	38.74b	34.77b	32.89
T_4	45.73a	51.40a	52.17a	52.58a	53.05a	55.93a	51.81a	--
LSD (0.05)	1.37	1.01	1.32	2.06	1.58	1.62	1.99	--
CV(%)	2.12	2.38	3.20	3.22	3.04	3.15	3.27	--

*DAIR= Days after insect release. Figures in a column accompanied by similar letter(s) do not differ significantly at 0.05 level of probability as per DMRT. [T_1 =Camphor @ 1 g/kg mungbean grain, T_2 =Phostoxin @ 200 mg/kg mungbean grain, T_3 =Naphthalene @ 500 mg/kg mungbean grain, T_4 = Untreated control]

From the above findings it was revealed that among three fumigant based treatments, the T_1 comprised of camphor @ 1

g/kg mungbean grain performed as the best treatment, which reduced the highest grain infestation (49.65%) over control

followed by T₂ (43.13%) comprised of phostoxin @ 200 mg/kg grain. On the other hand, the lowest grain infestation reduction over control (32.89%) was achieved in T₃ comprised of naphthalene @ 500 mg/kg grain. The order of efficacy of different fumigants against *C. chinensis* in terms of grain infestation reduction by number is T₁ > T₂ > T₃. Another findings obtained by Ahmed *et al.* (2006) was similar. They experimented in mungbean seeds and were stored for two years in different containers with two types of chemicals (naphthalene and camphor) and two types of indigenous materials (sand and neem leaf powder). They observed that camphor provided better protection than other materials for all the containers and storage period.

Effect of fumigants on grain infestation by weight

The significant variations were observed among different fumigants based management practices in terms of grain infestation by weight throughout the storing period starting from 20 to 120 DAIR considering 20 days interval during the management of pulse beetle, *C. chinensis* on mungbean. In case

of 20 DAIR, the highest grain infestation was recorded in T₄ (42.08%) which was statistically different from all other treatments followed by T₃ (31.25%) (Table II). On the other hand, the lowest grain infestation (19.17%) was recorded in T₁. In case of 40 DAIR, the highest grain infestation by weight (43.75%) was recorded in T₄ which was statistically different from all other treatments followed by T₃ (32.92%) (Table II). On the other hand, the lowest grain infestation was recorded in T₁ (20.00%). More or less similar trends of results were also recorded in case of 60, 80, 100 and 120 DAIR in terms of percent grain infestation by weight. Considering the mean grain infestation by weight, the highest grain infestation (46.11%) was recorded in T₄, which was statistically different from all other treatments followed by T₃ (34.86%). On the other hand, the lowest grain infestation was recorded in T₁ (23.27%). In case of grain infestation reduction over control, the highest reduction (49.54%) was recorded in T₁ followed by T₂ (26.80%). On the other hand, the lowest grain infestation reduction (24.40%) over control was recorded in T₃.

Table II: Effect of fumigants on the mungbean grain infestation by weight against *C. chinensis* during April to July, 2011

Treatment	% Grain infestation by weight							%infestation reduction over control
	20 *DAIR	40 DAIR	60 DAIR	80 DAIR	100 DAIR	120 DAIR	Mean	
T ₁	19.1d	20.0c	22.5c	25.00c	26.2c	26.67c	23.27c	49.54
T ₂	26.6c	31.6b	32.5b	36.25b	37.5b	37.92b	33.75b	26.80
T ₃	31.2b	32.9b	33.3b	35.00b	38.3b	38.33b	34.86b	24.40
T ₄	42.0a	43.7a	45.8a	47.08a	47.9a	50.00a	46.11a	--
LSD (0.05)	1.15	1.68	1.88	1.49	2.01	1.81	1.65	--
CV(%)	3.22	3.62	3.29	2.55	3.23	2.86	3.85	--

*DAIR= Days after insect release. Figures in a column accompanied by similar letter(s) do not differ significantly at 0.05 level of probability as per DMRT. [T₁=Camphor @ 1 g/kg mungbean grain, T₂=Phostoxin @ 200 mg/kg mungbean grain, T₃=Naphthlene @ 500 mg/kg mungbean grain, T₄= Untreated control]

From the above findings it was revealed that among three fumigant based treatments, T₁ comprised of camphor @ 1 g/kg grain performed as the best treatment, which reduced the highest grain infestation (49.54%) over control followed by T₂ (26.80%) comprised of phostoxin tablet @ 200 mg/kg grain. On the other hand, the lowest grain infestation reduction (24.40%) over control was achieved by T₃ comprised of naphthlene @ 500 mg/kg mungbean grain. The order of efficacy of different fumigants against *C. chinensis* in terms of grain infestation reduction by weight is T₁ > T₂ > T₃. Ahmed *et al.* (2006) found similar findings in mungbean seeds taht were stored for two years in different containers with two types of chemicals (naphthalene and camphor) and two types of indigenous materials (sand and neem leaf powder). They observed that camphor provided better protection than other materials for all the containers and storage period.

Effect of fumigants on the adult emergence of *C. chinensis*

The significant variations were observed among different fumigant based management practices in terms of adult emergence by number throughout the storing period starting from 40 to 120 DAIR considering 20 days interval during the

management of pulse beetle, *C. chinensis* on mungbean. In case of 40 DAIR, the highest number of adult emergence was recorded in T₄ (3.67/10 infested seed) which was statistically different from all other treatments followed by T₃ (0.67/10 infested seed) (Table III). On the other hand, no adult was emerged from T₁ (0.00/10 infested seed) and T₂ (0.00/10 infested seed).In case of 60 DAIR, the highest number of adult emergence (6.00/10 infested seed) was recorded in T₄ which was statistically different from all other treatments followed by T₃ (1.00/10 infested seed) (Table III). On the other hand, the lowest number of adult emergence was recorded in T₁ (0.33/10 infested seed). More or less similar trends of results were also recorded in case of 60, 80, 100 and 120 DAIR in terms of adult emergence by number of pulse beetle during its management.Considering the mean adult emergence, the highest number of adult emergence (6.27/10 infested seed) was recorded in T₄, which was statistically different from all other treatments followed by T₃ (1.73/10 infested seed). On the other hand, the lowest number of adult emergence was recorded in T₁ (1.40/10 infested seed). In case of adult emergence reduction over control, the highest reduction (77.66%) was recorded in T₂ followed by T₁ (74.47%).

On the other hand, the lowest adult emergence reduction (72.37%) was recorded in T₃.

Table III: Effect of fumigants on adult emergence during 40 days after insect release to 120 days after insect release of *C. chinensis*

Treatment	Adult emergence (No./10 infested seeds)					Mean	%reduction over control
	40 *DAIR	60 DAIR	80 DAIR	100 DAIR	120 DAIR		
T ₁	0.00c	0.33c	0.67d	2.33b	3.67b	1.40c	77.66
T ₂	0.00c	0.33c	1.67b	2.33b	3.67b	1.60b	74.47
T ₃	0.67b	1.00b	1.33c	2.33b	3.33c	1.73b	72.37
T ₄	3.67a	6.00a	6.67a	7.33a	7.67a	6.27a	--
LSD (0.05)	0.03	0.08	0.07	0.09	0.08	0.18	--
CV(%)	2.67	3.34	3.23	3.66	3.11	3.25	--

*DAIR= Days after insect release. Figures in a column accompanied by similar letter(s) do not differ significantly at 0.05 level of probability as per DMRT. [T₁=Camphor @ 1 g/kg mungbean grain, T₂=Phostoxin @ 200 mg/kg mungbean grain, T₃=Naphthlene @ 500 mg/kg mungbean grain, T₄= Untreated control]

From the above findings it was revealed that among three fumigant based treatments, the T₁ comprised of camphor @ 1 g/kg mungbean grain performed as the best treatment, which reduced the highest adult emergence by number (77.66%) over control followed by T₂ (74.47%) comprised of phostoxin @ 200 mg/kg grain. On the other hand, the lowest adult emergence reduction over control (72.37%) was achieved by T₃ comprised of naphthalene @ 500 mg/kg grain. The order of efficacy of

different fumigants against *C. chinensis* in terms of adult emergence reduction is T₁> T₂> T₃. Similar finding was found by Latif *et al.* (2005) in case of rice weevil, *Sitophilus oryzae* Linn. (Curculionidae: Coleoptera) in parboiled polished rice grains against camphor and they found that there exists a very sharp difference. The LD₅₀ camphor against adult, egg, larva and pupa was the lowest.

Effect of fumigants on the grain content loss

Percent (%) grain content loss was also significantly varied among different fumigants applied against pulse beetle, *C. chinensis* during its management.

Table IV: Effect of fumigants on mungbean grain content loss during 120 days after insect release of *C. chinensis*

Treatment	% grain content loss by weight	%grain content loss reduction over control
T ₁	2.33c	95.18
T ₂	3.00b	93.79
T ₃	3.00b	93.79
T ₄	48.33a	--
LSD (0.05)	0.06	--
CV(%)	3.12	--

Figures in a column accompanied by similar letter(s) do not differ significantly at 0.05 level of probability as per DMRT. [T₁=Camphor @ 1 g/kg mungbean grain, T₂=Phostoxin @ 200 mg/kg mungbean grain, T₃=Naphthlene @ 500 mg/kg mungbean grain, T₄= Untreated control]

After the completion of the experiment (i.e. at 120 DAIR), it was observed that the highest grain content loss was achieved by T₄ (48.33%), which was statistically different from all other treatments followed by T₂ (3.00%) (Table IV). On the other hand, the lowest grain content loss (2.33%) was observed in T₁. In case of grain content loss reduction over control, the highest reduction (95.18%) was recorded in T₁, which was more or less similar but significant with other two fumigants such as T₂ (93.79) and T₃ (93.79). From the above findings it was revealed that among three fumigant based treatments, the T₁ comprised of camphor @ 1 g/kg grain performed as the best treatment, which reduced the highest grain content loss (95.18%) over control. On

the other hand, the lowest grain content loss reduction over control (93.79%) was achieved by T₂ comprised of phostoxin tablet @ 200 mg/kg grain. The order of efficacy of different fumigants against *C. chinensis* in terms of grain content loss reduction is T₁> T₂, T₃. The better performance from camphor under the present study might be due to cause of its chemical action which is comparatively better than the others against pulse beetle in mungbean and gave ultimately the best results. Here camphor effectively reduced the pulse beetle infestation and that causes reduced grain content loss.

Effect of fumigants on germination of mungbean seed

The significant variations were also observed among three fumigant based management practices in terms of percent seed germination throughout the storing period starting from 20 to 120 DAIR considering 20 days interval during the management of pulse beetle, *C. chinensis* on mungbean. In case of 20 DAIR, the maximum seed germination was recorded in T₁ (94.67%) which was statistically identical with all other treatments (Table V). On the other hand, the lowest seed germination in T₄ (84.67%).In

case of 40 DAIR, the maximum seed germination (94.00%) was observed in T₁ which was statistically different from all other treatments followed by T₂ (92.67%) (Table V). On the other hand, the lowest seed germination was recorded in T₄ (77.33%). More or less similar trends of results were also recorded in case of 60, 80, 100 and 120 DAIR in terms of percent mungbean seed germination.

Table V: Effect of fumigants on the germination of mungbean during 20 days after insect release to 120 days after insect release of *C. chinensis*

Treatment	% seed germination							%germination increase over control
	20 *DAIR	40 DAIR	60 DAIR	80 DAIR	100 DAIR	120 DAIR	Mean	
T ₁	94.6a	94.0a	93.3a	90.6a	90.0a	90.0a	92.1a	26.57
T ₂	94.6a	92.6b	91.3b	90.6a	90.0a	89.3a	91.4b	25.65
T ₃	92.6b	91.3c	91.0b	90.0a	90.0a	87.3b	90.3c	24.20
T ₄	84.6c	77.3d	73.3c	70.0b	67.3b	64.0c	72.7d	--
LSD (0.05)	0.31	0.18	0.26	0.21	0.38	0.26	0.22	--
CV(%)	3.17	3.39	3.29	2.55	3.69	3.16	3.63	--

*DAIR= Days after insect release. Figures in a column accompanied by similar letter(s) do not differ significantly at 0.05 level of probability as per DMRT. [T₁=Camphor @ 1 g/kg mungbean grain, T₂=Phostoxin @ 200 mg/kg mungbean grain, T₃=Naphthlene @ 500 mg/kg mungbean grain, T₄= Untreated control]

Considering the mean germination, the maximum seed germination (92.11%) was recorded in T₁, which was statistically different from all other treatments followed by T₂ (91.45%). On the other hand, the lowest percent germination in T₄ (72.78%). In case of increase in percent germination of mungbean seed over control, the highest increase (26.57%) was recorded in T₁ followed by T₂ (25.65%). On the other hand, the lowest percent germination increase (24.20%) was recorded in T₃.

From the above findings it was revealed that among three fumigant based treatments, the T₁ comprised of camphor @ 1 g/kg mungbean grain performed as the best treatment, which increased the maximum seed germination (26.57%) over control followed by T₂ (25.65%) comprised of phostoxin tablet @ 200 mg/kg grain. On the other hand, the lowest grain germination increase over control (24.20%) was achieved by T₃ comprised of naphthlene @ 200 mg/kg grain. The order of efficacy of different fumigants in terms of seed germination increase over control is T₁> T₂> T₃. Generally seed viability is damaged with insect infection during storage condition. The better performance from camphor under the present study in terms of seed viability might be due to cause of its chemical action which is comparatively better than the others fumigant materials that were used against pulse beetle in mungbean and gave ultimately the best results. Similar findings were also found by Ahmed *et al.* (2006).

Considering the findings of the study, on stored mungbean camphor may be recommended for eco-friendly management of *Callosobruchus chinensis* Linn.

REFERENCES

[1] Afzal, M.A., Bakar, M.A., Halim, A., Haque, M.M. and Akter, M.S. (2004). Mungbean in Bangladesh. Lentil Blackgram and Mungbean Development Pilot Project, BARI, Gazipur-1701. Pub. No-23. P.60.

[2] Ahmed, M.S., Kabir, K.H., Nahar, G., Miah, M.R.U. and Rahman, M.A. (2006). Use of different containers, chemicals and indigenous materials for the management of pulse beetles (*Callosobruchus chinensis* L.) in storage. Bangladesh J. Entomol. 16(2): 11-22.

[3] Alam, M.Z. (1971). Pest of stored grains and other stored products and their control. The Agriculture Information Service, Publ. Dhaka-61.

[4] Ali, M.R., Rahman, M.M., Rahman, M.M., Ali, M. and Quamruzzaman, A.K.M. (1999). Studies on the host preference of pulse beetle, *Callosobruchus chinensis* Linn. to different pulses. J. Agric. Edu. Tech. 2(2): 139-144.

[5] Begum, A., Debnath, S.K. and Seal, D.R. (1984). Studies on the food, temperature and humidity on the fecundity and development of *Callosobruchus chinensis* Fab. (Coleoptera: Bruchidae). Bangladesh J. Zool. 12(2): 71-78.

[6] Bryn, C. (2002). Study on stored grain pests and industrial use of chemicals. Bangladesh. J. Training Develop. 16(2): 108-110.

[7] Chandra, S., Khare, B.P. and Sharma, V.K. (1989). Efficacy of some selected fumigants on rice-weevil, *Sitophilus oryzae* Linn. Indian J. Agril. Res. 12(2): 79 - 84.

[8] Dilwari, V. K.D.G. Dhaluiwal and M.S. Mahal. 1991. Toxicity of allylthioiocyanate to rice moth. *Sitotroga cerealella* Linn. J. Insect. Sci. 4(1):101-102.

[9] Fletcher, T.B and Ghosh, C.C. (2002). Stored grain pests. Rep. Proc. 3rd Ent. Meeting, Pusa, New Delhi, pp. 712-716.

[10] Khosla, R.K. (1997). Techniques for assessment of losses due to pest and diseases of rice. Indian J. Agric. Sci. 47(4): 171-174.

[11] Latif, M.A., Rahman, M.M. and Alam, M.Z. (2005). Fumigation toxicity of camphor against different developmental stages of *Sitophilus oryzae* Linn. in rice. Bangladesh J. Entomol. 15(1). 37-44.

[12] Mahadi, M.R. and Hamoudi, R.F. (2010). Effect of some plant oil on the control of cowpea weevil, *Callosobruchus maculatus* F. (Coleoptera: Bruchidae). J. Agric. Water Reso. Res. 3(2): 104-110.

[13] Miah, M.A. (2007). Resistance source(s) among different varieties against pulse beetles their alternative management. M.S. Thesis, Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh. P. 82.

[14] Onu, I. and Aliyu, M. (1995). Evaluation on nature of damage and control of *Callosobruchus* spp. (F). for stored cereal grains. International J. Pest Manage. 41(3): 143-145.

- [15] Prakash, A, and Rao, J. (1983). Insect pests and their management in rice storage in India, presented in National Symposium on Maximising and Stabilising of yields on rain fed rice production system held at CSRRRI, Cuttack (India) on Feb., pp. 23 -25.
- [16] Rahman, M.M., Mannan, M.A. and Islam, M.A. (1981). Pest survey of major summer and winter pulse in Bangladesh. In proceeding the National Workshop on pulse, held during August 18-19, 1981. Bangladesh Agricultural Research Institute, Joydebpur, Dhaka. pp. 265-273.
- [17] Rahman, M.M., Shaha, S.K., Kundu, R. and Karim, A.J.M.S. (2001). Fumigation toxicity of camphor against different developmental stages of (*Callosobruchus chinensis* Linn. in Chickpea. Bangladesh J. Entomol., 11(2): 107-115.
- [18] Rahman, S. (1971). Study on the morphology and biology of *Callosobruchus chinensis* Linn. C. analis Fab and extent of damage to pulses, M.Sc. Thesis, Dept. of Zoology, Dacca University. p.199.
- [19] Singh, D., Siddiqui, M.S. and Sharma S. (1989). Reproduction retardant and fumigant properties of essentials oils against rice weevil (Coleoptera: Cuculionidae), in stored wheat. J. Econ. Entomol. 82(3): 727 - 733.
- [20] Srivastava, S., Gupta, K.C. and Agarwal, A. (1980). Effect of plant product on *Callosobruchus chinensis* L. infestation on red gram. Rev. Appl. Entomol. 77(9): 781.
- [21] Yadav, D.S., Panwar, K.S. and Sing, V.K. (1994). Management of pulse crops in sequential cropping. Indian Abst. Proc. Intercropping. Symposium on pulse Research. 2-6 April, 1994, New Delhi, India. 27p.
- [22] Yadav, T.D. (1983). Seed fumigation as an aspect to seed storage technology. Seed Res., 11(2): 240 - 247.

AUTHORS

First Author – Md. Zahid Khan, B.Sc.Ag.(Hons.), M.S in Entomology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, e-mail- zkhan_102@yahoo.com

Second Author – Professor Dr. Md. Razzab Ali, Dept. of Entomology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, e-mail- razzab1968@yahoo.com

Third Author – Professor Dr. Md. Serajul Islam Bhuiyan Dept. of Entomology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, e-mail- dmseraj@hotmail.com

Fourth Author – Md. Awlad Hossain, B.Sc.Ag.(Hons.), M.S in Agricultural Chemistry(Thesis semester), Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, e-mail- awladsau@gmail.com

Sixth Sense Technology & Its Applications

Ranjeet Daroga*, Nishantraj Pandey**

* ETRX ENGINEERING, Thakur College Of Engineering and Technology ,Mumbai, Maharashtra, India
** MECHANICAL ENGINEERING, Thakur College Of Engineering and Technology ,Mumbai, Maharashtra, India

Abstract- In this paper we worked on a new type of technology which is going to be soon launched in the market .Its name is the sixth sense technology. It's a wearable interface that augments the physical world around us with the digital information. It's just born concept which allows user to connect with the internet seamlessly. Without use of keyboard, mouse we can see videos access, change, move data simply.

Index Terms- speech IC, projector, mobile device

I. INTRODUCTION

This technology is a revolutionary way to interface the physical world with digital information. Modern technologies include the touch screen techniques which is used widely and it makes ease of operation and saves utilisation time. Sixth sense is a wearable gestural interface that augments the physical world around us with digital information and lets us use natural hand gestures to interact with that information. But the bottle necks of this method such as position of camera, for capturing gestures interprets the accuracy in the projected output, lead to use of commands instead of hand gestures. The position of camera is a major constraint in the image capturing and projected output efficiency and accuracy. Therefore the actions which we regularly perform in our daily life, are converted to commands and are trained to a speech IC .They are stored as a database in the integrated circuit and corresponding actions are performed when the speech is recognised from the user.

It's a hi-tech device seamlessly integrate Analog information with our everyday physical world. The voice is directly performed into operation within fractions of seconds, and the action is projected on the surface. It's a portable device and eases the operation which we regularly perform. Basically the sixth sense technology concept involves the use of hand gestures .the finger tip will contain coloured markers and hence gestures performed will be captured by the camera. Then it's given to the mobile device for the corresponding action to be performed. The action is projected on the surface through the projector. Software algorithms and computer vision technologies will be used to enable the action from the mobile device for the corresponding gesture captured in the camera. This gesture based technology is used for variety of applications like performing basic actions, locating points in the map, watching video in newspaper, dialling number in hand etc. The slight modification of this method lead to the use of commands that is analog information into real world. The analog data is converted into digital and performed as action, as all times the hand gestures cannot be used.

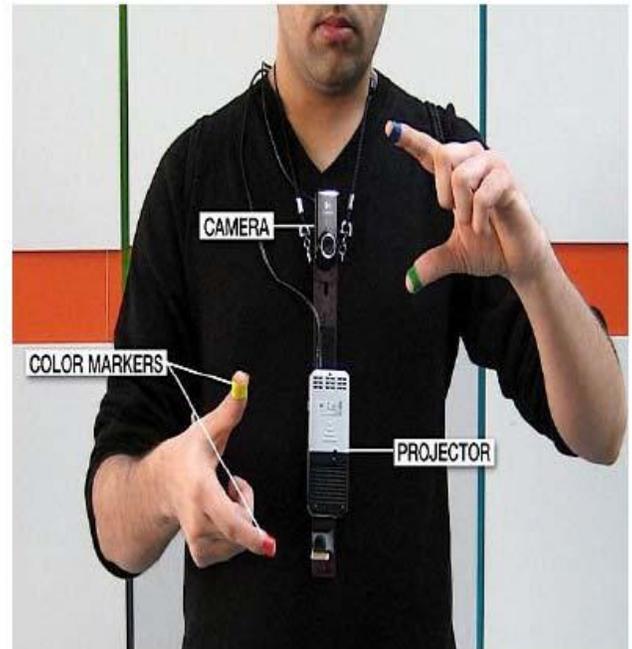


Fig1: Representation Of Gesture Based Design

This was how the wearable device is fit to the human body .Here colour markers are used in the finger tips .In our technology we use commands for performing the same operations. Many high technology speech integrated circuits evolved which makes our operation enhanced with more advanced features.

To ensure accurate gesture recognition and an intuitive interface a number of constraints are applied. A region in the front of the projection screen is defined as the active zone and the gestures are ignored, if the gestures are performed out of this area. Gestures are also defined by a set start posture, end posture and dynamic motion between the start and end postures. Perhaps the use of gestures is most powerful when combined with other input modalities, especially voice. Allowing combined voice and gestural input has several tangible advantages. The first is purely practical-ease of expression .Ease corresponds to the efficiency with which commands can be remembered and expressiveness, size of command vocabulary.

II. DESIGN AND WORKING

The sixth sense device comprises of

1. Wearable projector
2. Mobile device

3. Speech IC
4. Mirror

The sixth sense device is a mini projector coupled with a speech IC and a cellphone, which acts as a computer and our connection to the cloud, all the information stored on the web. The components are controlled by or communicated with a mobile computing device carried in the user's pocket. The hardware components are coupled in a pendant like mobile wearable device .both the speech IC and the projector are connected to the mobile computing device in the user's pocket. The projector, projects the visual information enabling surfaces, walls and physical objects around the user to be used as interfaces. While the speech IC stores commands which were trained by the user and executes the corresponding action through the projector, enabling the actions from the mobile device.

A remote computer can also be connected which gathers data from user ,processes it, searches the web for relevant execution of the command and returns the result in real time to the user. The speech IC is trained with regularly used operating data and thus it acts as a database for storing all such commands.

There evolved many speech integrated circuits with fabulous technical aspects to be embedded for vast kind of applications. There are three ways for speech recognition and language understanding. 1. Multipurpose processors intended for embedded applications. 2. Customised integrated circuits for speech recognition and language understanding.3.implementing speech recognition and language understanding as part of larger integrated circuit in the device.

Some integrated circuits can be used for less than 15 words, which have a menu based type of interaction whereas other ASIC integrated circuits can be used for hundreds of words which posses natural language understanding. The IC will be trained with a sophisticated neural network to recognise the commands and activate it correspondingly. The speech IC is initially trained with the words or commands .The user gives the input as commands and when such analog speech is received to the IC ,the data is converted into digital and is sent to the mobile device .the mobile device activates the command and is given in turn to the projector. The projector output is seen on the screen through the mirror for accurate projection from the projector which is wearable in the body. For more advanced operations and for accessing net which is our future work, can be accessed from the remote computer simultaneously and projected as before.

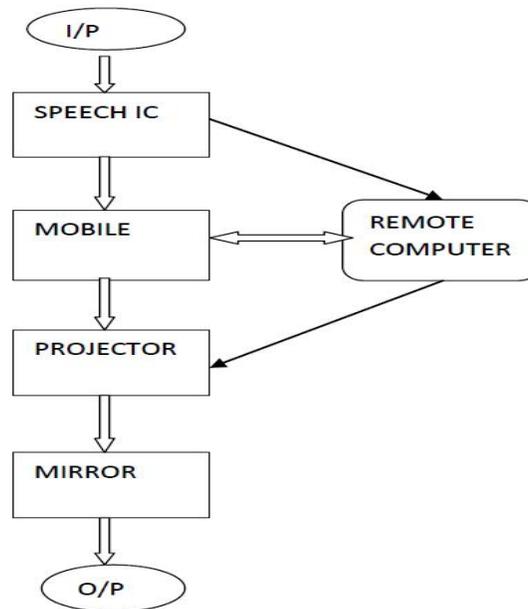


Fig 2: Basic Design of Our Concept

III. APPLICATIONS

The Sixth Sense prototype implements several applications that demonstrate the usefulness, viability and flexibility of the system. The SixthSense device has a huge number of applications. You can use the Sixth Sense to project a keypad onto your hand, then use that virtual keypad to make a call. Calling a number also will not be a great task with the introduction of Sixth Sense Technology. No mobile device will be required, just type in the number with your palm acting as the virtual keypad. The keys will come up on the fingers. The fingers of the other hand will then be used to key in the number and call. The sixth sense also implements map which lets the user display the map on any physical surface and find his destination and he can use his thumbs and index fingers to navigate the map, for example, to zoom in and out and do other controls. Sixth Sense all we have to do is draw a circle on our wrist with our index finger to get a virtual watch that gives us the correct time. The computer tracks the red marker cap or piece of tape, recognizes the gesture, and instructs the projector to flash the image of a watch onto his wrist. The Sixth Sense system also augments physical objects the user is interacting with by projecting more information about these objects projected on them. For example, a newspaper can show live video news or dynamic information can be provided on a regular piece of paper. Thus a piece of paper turns into a video display. The user can zoom in or zoom out using intuitive hand movements. The drawing application lets the user draw on any surface by tracking the fingertip movements of the user's index fingering formation Maes says Sixth Sense uses image recognition or marker technology to recognize products you pick up, then feeds you information on books. The system can project Amazon ratings on that book, as well as reviews and other relevant information Product information Maes says Sixth



Fig 3. Example Of Commonly Used Applications

Sense uses image recognition or marker technology to recognize products you pick up, then feeds you information on those products. For example, if you're trying to shop "green" and are looking for paper towels with the least amount of bleach in them, the system will scan the product you pick up off the shelf and give you guidance on whether this product is a good choice for you. Pictures If we fashion our index fingers and thumbs into a square (the typical "framing" gesture), the system will snap a photo. After taking the desired number of photos, we can project them onto a surface, and use gestures to sort through the photos,

and organize and resize them .The system will recognize your boarding pass and let you know whether your flight is on time and if the gate has changed.

IV. THE INVENTOR

Pranav Mistry, 28 year old, of Indian origin is the mastermind behind the sixth sense technology. He invented ' Sixth Sense / WUW (Wear UR World) ' which is a wearable gestural , user friendly interface which links the physical world around us with digital information and uses hand gestures to interact with them .He is a PhD student at MIT and he won the 'Invention of the Year 2009 ' - by Popular Science

V. CONCLUSION

The sixth sense technology using gesture movement and speech integrated circuits are emerging innovative ideas. We have a seamless access to data or information that may exist to help us make decisions. This provides access to relevant information about the things in the environment and enables the new interactions between the real world and the world of data. Although the miniaturisation of computing devices allows us to carry computers in our pockets, there had been no link between the digital devices we carry and our interactions with the physical world, and our speech in a efficient level .Sixth sense is developed to seamlessly integrate information into reality. The future may depend upon this sixth sense. May be within this 2020, the proliferation and the use of this technology is immense. Sufficient awareness of the sixth sense will lead to further development of any technology which aids for getting information and performing any type of action practically at any time, using simply the gestures and commands given .The advantage of this technology is portable, its connectedness between the world and the information as speech. Its cost effectiveness and data can accessed from the machine directly in real time. It can also be said as an open source technology. Within twenty years this technology will bring a drastic change in field of science and will create a revolutionary change among the mass. The device will soon be up for sale and will be available to the common public the device will cost around 350\$ without the custom made PC. which aids for getting information and performing any type of action practically at any time, using simply the gestures and commands given.

The advantage of this technology is portable, its connectedness between the world and the information as speech. Its cost effectiveness and data can accessed from the machine directly in real time. It can also be said as an open source technology. Within twenty years this technology will bring a drastic change in field of science and will create a revolutionary change among the mass.

ACKNOWLEDGEMENT

I thank Mr.N.Kumaresan, lecturer, ECE department, for his valuable guidance and motivation for this work and also I thank my other department staff members for their credit in completion of this paper.

REFERENCES

- [1] Alon, J. Athitsos, V. Quan, Yuan Sclaroff, S. Computer Science Dept., Boston Univ., Boston, MA, USA, A Unified Framework for Gesture Recognition and Spatiotemporal Gesture Segmentation, IEEE transactions on Pattern Analysis and Machine Intelligence, Volume: 31, Issue:9 pp 1685 - 1699 ., Sept. 2009
- [2] Mu-Chun Su Inst. of Computer Science & Inf. Eng., Nat. Central Univ., Chung-Li A fuzzy rule-based approach to spatio-temporal hand gesture recognition, Systems, Man, and Cybernetics, Part C: Applications and Reviews, IEEE Transactions on Volume: 30, Issue:2 pp276 - 281., May 2000
- [3] Kirishima, T. Sato, K. Chihara, K. Dept. of Electr. Eng., Nara Nat. Coll. of Technol., Japan Robotics, Gesture Spotting and Recognition for Human-Robot Interaction, IEEE Transactions on Volume: 23, Issue:2 pp256 - 270., April 2007
- [4] Real-time gesture recognition by learning and selective control of visual interest points: Pattern Analysis and Machine Intelligence, IEEE Transactions on, Volume: 27, Issue:3, pp351 - 364., March 2005
- [5] Ozer, I.B. Tiejun Lu Wolf, W. Princeton Univ., NJ, USA Design of a real-time gesture recognition system: high performance through algorithms and software Signal Processing, IEEE Volume: 22, Issue:3, pp 57 - 64., May 2005
- [6] Evans, J.R. Tjoland, W.A. Allred, L.G. Ogden Air Logistics Center, Hill AFB, UT Achieving a hands-free computer interface using voice recognition and speech synthesis [for Windows-based ATE] Aerospace and Electronic Systems, IEEE Volume: 15, Issue:1, pp 14-16., Jan 2000
- [7] Kaynak, M.N. Qi Zhi Cheok, A.D. Sengupta, K. Zhang Jian Ko Chi Chung Dept. of Electr. Eng., Arizona State Univ., Tempe, AZ, USA Analysis of lip geometric features for audio-visual speech recognition Systems, Man and Cybernetics, Part A: Systems and Humans, IEEE Transactions on Volume: 34, Issue: 4, pp-564 - 570., July 2004
- [8] Gomez, A.M. Peinado, A.M. Sanchez, V. Rubio, A.J. Dept. eoria de la Senal, Granada Univ Recognition of coded speech transmitted over wireless channels Wireless Communications, IEEE Transactions on Volume: 5, Issue: 9, pp-2555 - 2562., September 2006
- [9] Pelaez-Moreno, C. Gallardo-Antolin, A. Diaz-de-Maria, F. Dept. de Tecnologias de las Comunicaciones, Univ. Carlos III de Madrid, Recognizing voice over IP: a robust front-end for speech recognition on the world wide web Multimedia, IEEE Transactions on Volume: 3, Issue:2, pp-209 - 218., Jun 2001
- [10] <http://boingboing.net/2009/11/12/sixthsense-technology.html>
- [10] <http://theviewspaper.net/sixth-sense-technology-will-revolutionise-the-world/>

AUTHORS

First Author – Ranjeet Daroga, ETRX ENGINEERING, Thakur College Of Engineering and Technology ,Mumbai, Maharashtra, India, Email: ranjeetdaroga5@gmail.com

Second Author – Nishantraj Pandey, MECHANICAL ENGINEERING, Thakur College Of Engineering and Technology ,Mumbai, Maharashtra, India, Email: pandeynishantraj@gmail.com

Investigation and Comparative Study of Effect of Silica Fume in Cementitious Grouts

Dr. Shrikrishna A.Dhale

Head & Associate Professor, Department of Civil Engineering, Priyadarshini College of Engineering, Nagpur, Distt Nagpur (India)

Abstract- Critical investigation were carried out to study the effect of silica fume on the compressive strength of cementitious grouts. The silica fume was added in different percentages of total mix, the percentages were 2%, 3.5%, 5%, 6.5%, and 8%. Cement component in the grout mix was varied between 30% to 50%, 13% water and 0.7% Salphonated naphthalene-formaldehyde condensate (SNF) were added in all mixes. Cementitious material like plaster of paris and aluminium powder were also added in fixed percentages of 3% and 0.005%. Total number of mixes studied was 25. Increase in cement component is found to have increased the compressive strength, however the addition of silica fume in different proportions have contributed to compressive strength development. It is observed that 2% of silica fume and 3.5% of silica fume has resulted in better compressive strengths. The results obtained are critically analysed and are presented and discussed in this paper.

Index Terms- Aluminum powder, Silica fume, Compressive strength, Flow test.

I. INTRODUCTION

Grout is a construction material used to for repairing structural cracks, covering embedded rebar in masonry walls, connect precast concrete, fill voids etc. It is basically a mixture of cement, sand, and water having defined properties related to compressive strength, flow and shrinkage. It is applied as a thick emulsion and hardens over time.

Cementitious grout is a combination of cement, sand, water and admixture. A wide variety of different filler materials may be added to enhance properties of grout. Grout can have virtually any consistency, ranging from a true fluid to a very stiff mortar like state. It will generally harden at some point after injection, so as to become immobile, and can be designed to have a wide variety of both bond and compressive strengths.

The silica fume is used in cementitious grouts as an admixture, which normally used as a cementitious material which increases the compressive strength of Grouts.

II. EXPERIMENTAL PROGRAMME

2.1 Material used.

The materials used for this experimental work are cement, sand, water, Aluminum powder. Plaster of Paris, silica fume, and super plasticizer.

2.1.1 Cement

Ordinary Portland cement of 53grade was used in this experimentation conforming to IS-12269-1987.

2.1.2 Sand

Locally available sand with specific gravity 2.65, maximum Bulk density is 15.8 KN/m³ and conforming to zone II as per IS - 383-1970.

2.1.3 Silica fume

Silica fume having fineness by residue on 45 micron sieve = 0.8 %, specific gravity = 2.2, Moisture Content = 0.7% was used. The chemical analysis of silica fume has indicated (Grade 920-D): silicon dioxide = 89.2%, LOI at 975[degrees] C = 1.7% and carbon = 0.92%, they are conforming to ASTM C1240-1999 standards.

2.1.4 Plaster of Paris. (POP)

Gypsum plaster or plaster of Paris is produced by heating gypsum to about 300° f (150°c). Locally available Plaster of Paris was used in the study.

2.1.5 Aluminum powder

Aluminum powder (AL₂O₃) available in market was used.

2.1.6 Super plasticizer

Salphonated naphthalene-formaldehyde condensate (SNF) was used to achieve the good flow of grouts.

2.1.7 Water

Potable water was used for experimentation.

2.2 Experimental methodology

2.2.1 Gap grading of sand was carried out to obtain Maximum Bulk density (As per ASTM -D1556). This was carried out to select right kind of graded sand. Details are presented in table 1

Table 1 (Sand Grading)

Sample	2 mm down 1mm retain	1 mm down 600µ retain	600µ down 150 µ retain	Volume ml	Weight gm	Density
T ₁	50%	25%	25%	248	390	1.57
T ₂	40%	30%	30%	216	342	1.58
T ₃	30%	30%	40%	208	332	1.59

T ₄	30%	40%	30%	218	336	1.54
T ₅	25%	50%	25%	214	325	1.52
T ₆	25%	25%	50%	218	339	1.55
T ₇	20%	40%	40%	198	310	1.56
T ₈	20%	45%	35%	206	318	1.54

From above sample T₂ & T₃ are considered for further testing, due to higher bulk density.

2.2.2 Determination of flow.

As flow is a major factor in cementitious grout. It has decided that the minimum flow required must be greater than 200 mm. The sample grouts were prepared with water percentage 12%, 13% & 14% of the total grout mix. Details are presented in table 2.

Table 2 (Flow of samples selected)

T ₂ sand Sample						
S.No	Cement 40%	Sand 60%	water %	Water by wt	Admixture (SNF)0.7%	Flow
1	200 gms	300 gms	12	60 gms	3.5 gms	190 mm
2	200 gms	300 gms	13	65 gms	3.5 gms	205 mm
3	200 gms	300 gms	14	70 gms	3.5 gms	220 mm
T ₃ Sand sample						
S.No.	Cement 40%	Sand 60%	water %	Water by wt	Admixture(SNF) 0.7%	Flow
1	200 gms	300 gms	12	60 gms	3.5 gms	180 mm
2	200 gms	300 gms	13	65 gms	3.5 gms	195 mm
3	200 gms	300 gms	14	70 gms	3.5 gms	210 mm

The flow obtained at 13% and 14% was quite good the cubes were casted and tested for 1day and 3days compressive strengths. Details are presented in table 3.

Table 3 (Compressive Strengths of selected samples)

Type	Water %	1 Days compressive strength	3 Days compressive strength
T2	13	17.21	39.09
T2	14	12.05	17.21
T3	13	19.29	36.58
T3	14	13.22	31.07

From above table it is concluded that at 13% of water, the flow is desirable and the strength is also sufficient. No significant effect on flow was observed, irrespective of change in proportions of basic ingredients.

2.2.3 Compressive Strength test

For compressive strength test of mortar cube specimens of dimension 50x50x50 mm were casted .Using various percentages of Micro silica, cement and sand, keeping SNF, POP and

Aluminum powder constant. After 24 hours the specimens were demoulded and put in the curing tank. The compressive strength of cubes was recorded for 1 day, 3day, 7day and 28day. Details are presented in table 4.

Graphs are plotted for **2%, 3.5%, 5%,6. 5%, and 8%** of Micro silica with **30%, 35%, 40%, 45%, 50%** of cement, they are presented in fig 1 to 6.

Table 4 (Compressive strength of reference mixes at different ages)

Cement%	Sand%	SNF%	1 Days MPa	3 Days MPa	7 Days MPa	28 Days MPa
30	70	---	13.77	23.97	28.21	44.83
35	65	----	19.36	34.80	46.03	71.36
40	60	----	22.17	41.91	56.63	62.49
45	55	----	37.35	55.20	65.08	76.92
50	50	----	37.40	51.43	60.35	76.48
30	70	0.7	0.00	18.21	22.75	34.08
35	65	0.7	8.71	28.31	40.19	58.41
40	60	0.7	17.61	43.53	56.97	68.81
45	55	0.7	24.24	45.07	50.97	61.44
50	50	0.7	34.28	55.13	65.53	73.11

Table 4 (Compressive strength of various mixes at different ages)

Cement %	Sand%	Silica Fume %	POP %	Al. Powder %	1 Days MPa	3 Days MPa	7 Days MPa	28 Days MPa
30	65	2	3	0.005	20.36	34.63	40.47	57.81
30	63.5	3.5	3	0.005	19.29	35.16	42.13	59.39
30	62	5	3	0.005	20.41	35.41	44.17	55.97
30	60.5	6.5	3	0.005	17.79	27.24	36.73	37.75
30	59	8	3	0.005	16.00	28.80	38.77	43.87
35	60	2	3	0.005	19.24	23.65	25.48	38.52
35	58.5	3.5	3	0.005	23.81	27.39	33.19	43.92
35	57	5	3	0.005	32.17	30.68	39.89	54.11
35	55.5	6.5	3	0.005	19.21	34.57	43.67	61.29
35	54	8	3	0.005	24.04	38.89	42.71	61.16
40	55	2	3	0.005	31.65	48.03	56.75	75.14
40	53.5	3.5	3	0.005	24.95	39.84	46.03	60.08
40	52	5	3	0.005	27.53	42.25	49.31	64.19
40	50.5	6.5	3	0.005	28.93	39.23	57.21	63.43
40	49	8	3	0.005	27.33	41.35	47.75	60.79
45	50	2	3	0.005	32.12	49.43	58.71	77.51
45	48.5	3.5	3	0.005	39.27	51.69	60.28	80.49
45	47	5	3	0.005	37.93	51.99	55.40	77.59
45	45.5	6.5	3	0.005	39.44	52.65	52.75	67.71
45	44	8	3	0.005	39.71	42.25	62.20	71.72
50	45	2	3	0.005	33.31	61.36	63.08	82.48

50	43.5	3.5	3	0.005	39.05	54.47	58.25	79.87
50	42	5	3	0.005	39.77	59.35	64.23	81.89
50	40.5	6.5	3	0.005	37.89	48.62	62.15	72.53
50	39	8	3	0.005	39.04	49.99	62.81	70.91

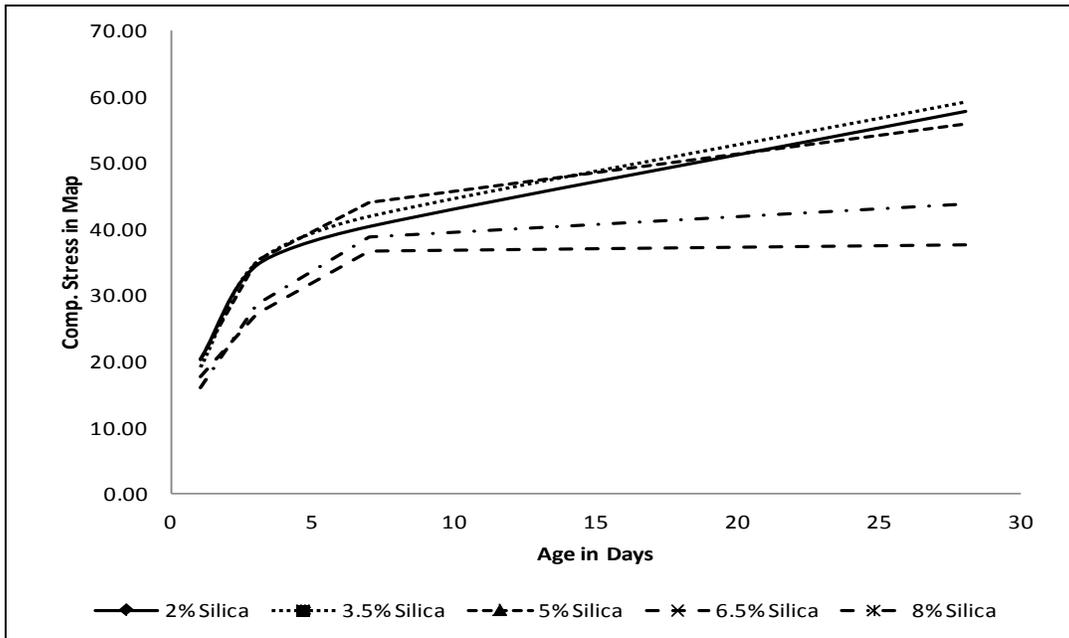


Fig 1 Compressive Stress Vs Age for 30% Cement Mixes

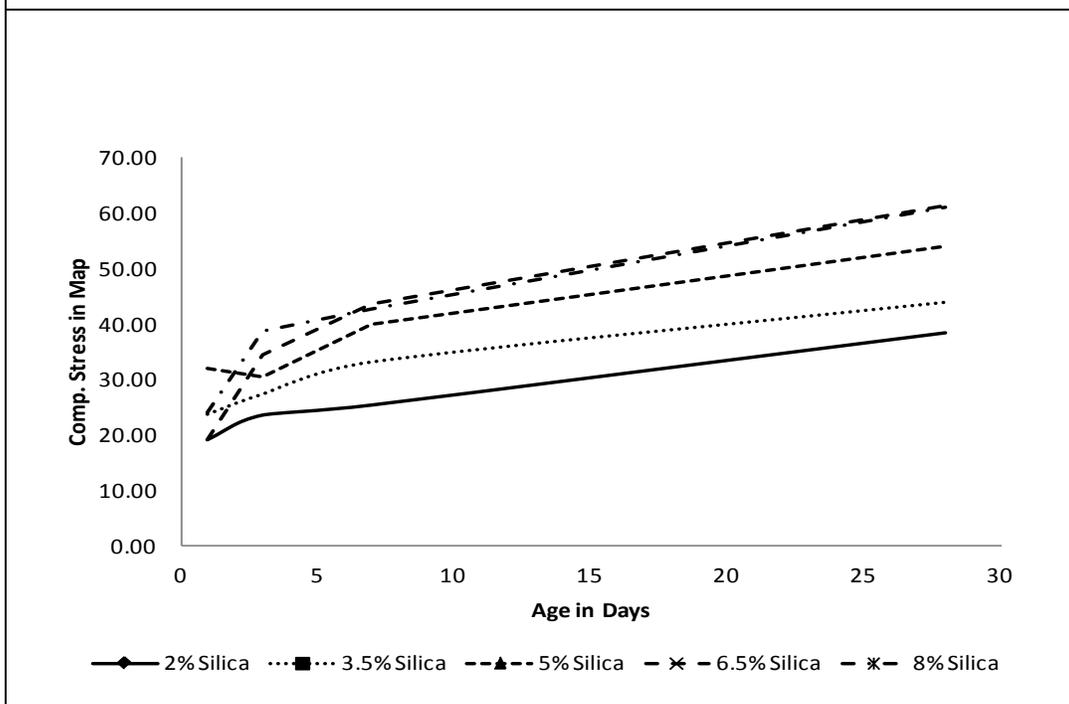


Fig 2 Compressive Stress Vs Age for 35% Cement Mixes

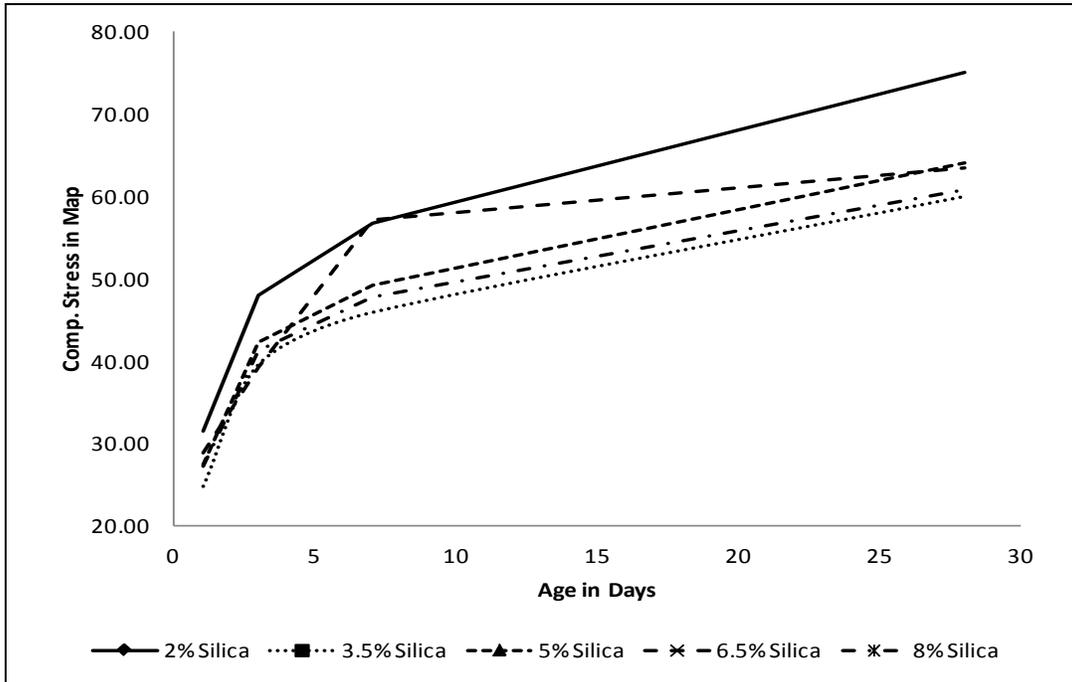


Fig 3 Compressive Stress Vs Age for 40% Cement Mixes

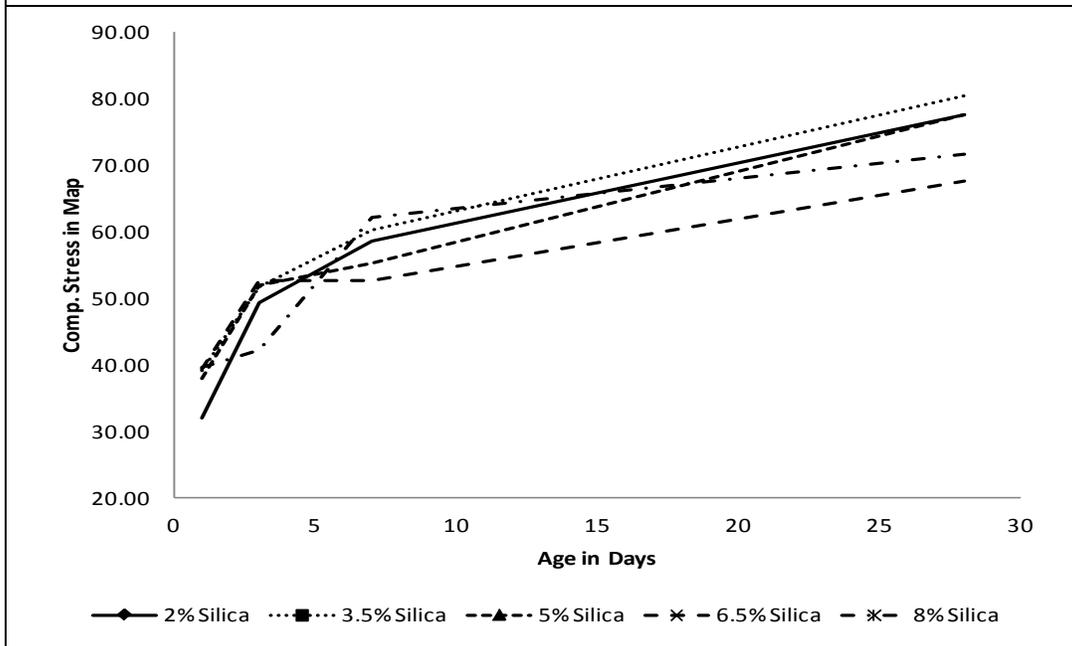


Fig 4 Compressive Stress Vs Age for 45% Cement Mixes

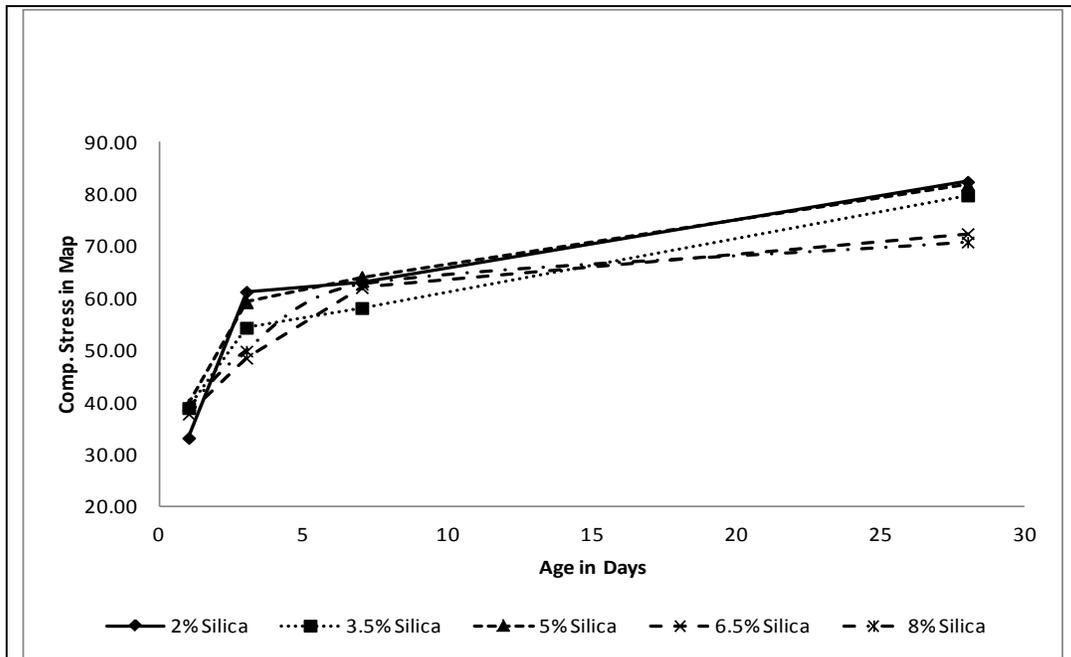


Fig 5 Compressive Stress Vs Age for 45% Cement Mixes

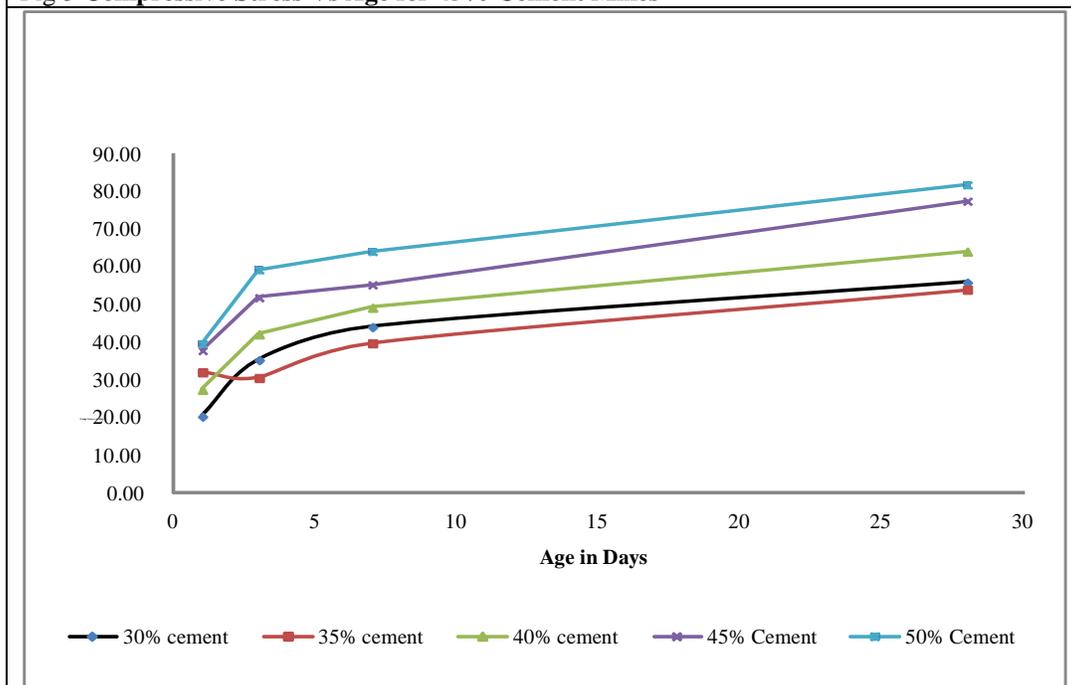


Fig 5 Compressive Stress Vs Age for 5% Silica fume

III. RESULT AND DISCUSSION

1. In 30% cement mixes , 3 days and 28 days compressive strength with 3.5% silica fume are found to be more than 2% , 5% , 6.5% and 8.5% silica fume.

2. In 35% cement mixes, 3days, 7days and 28 days compressive strength are found to increasing. With increase in percentage of silica fume

3. In 40% cement mixes, 1 day 3 days, 7 days and 28 day compressive strength with silica fume 2% found to be more than other mixes with 3% , 5% , 6.5% , 8.5% silica fume.

4. In 45% cement mixes, 28 days compressive strength with silica fume 3.5% found to be more than other mixes. Whereas 7 days compressive strength is more with 8% of silica fume then other mixer.

5 In 50% cement mixes, 3 days, 7 days and 28 day compressive strength with silica fume 2% found to be more than other mixes with 3% , 5% , 6.5% , 8.5% . silica fume.

IV. CONCLUSION

The following conclusions are drawn from the investigation carried out.

1. It is observed that with increase in percentage of cement in the grout the compressive strength normally increases.
2. It is observed that by increasing the percentage of silica fume above 6.5% the compressive strength is not increasing
3. It is observed that 2% of silica fume in 40% cement mixes and 50% cement mixes show very good increase in compressive strength.
4. The highest compressive strength observed at 50% cement mix with 2% of silica fume, is very good that is 82.48 mpa.
5. The comparison of percentage increase of compressive strength of the cementitious grout with reference grout shows increase from 5% to 40%.

REFERENCES

- [1] American Society for Testing And Materials(2002) Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method) (ASTM C 942-10)
- [2] American society for Testing and materials (2008).Standard specification for package Dry , Hydraulic cement Grout (Non shrink) (ASTM C 1107/c 1107M-08).
- [3] American society for Testing and materials (2001).Standard Test method for flow of, Hydraulic cement mortar (ASTM C 1437-01).
- [4] American society for Testing and materials (2008).Standard Test method for compressive strength of Hydraulic cement mortar (using 50 mm cube specimens) (ASTM C 109/c 109M-08).
- [5] American society for Testing and materials (2010).Standard specification for Silica fume used in cementitious mixtures (ASTM C 1240-10a).
- [6] American Society for Testing And Materials(2001). Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Concrete.(ASTM C 618-01)
- [7] American Society for Testing And Materials(2008). Standard Test Method for Flowability and Bearing area of Chemical- Resistant Polymer Machinery Grouts. (ASTM C 1339-02)
- [8] American Society for Testing And Materials(2010).Standard Practices for Proportioning Grout Mixtures for Preplaced-Aggregate Concrete.(ASTM C 938-10)
- [9] American society for Testing and materials (2002).Standard specification for Portland for Portland cement (ASTM C 150-02).
- [10] American Society for Testing And Materials(2010)) Standard Test Method for Expansion And Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory (ASTM C 940-10A)
- [11] American Society for Testing And Materials(2002) Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method) (ASTM)
- [12] James Warner, P.E (2004) Practical Hand book of Grouting.
- [13] S.K.LIM, F.Zakaria, M.W.Hussin. Effect of slag content to cement grouts on the compressive strength development in tropical weather environment .Proceeding of the 6th Asia –pacific structural Engineering and construction conference APSEC-2006 Kuala Lumpur, Malaysi.

AUTHORS

First Author – Dr. Shrikrishna A.Dhale, Head & Associate Professor, Department of Civil Engineering, Priyadarshini College of Engineering, Nagpur, Distt Nagpur (India), shri_dhale@rediffmail.com

Relationship between Information and Communication Technology and Small Scale Industrial Units of Northern India

Ankit Garg, Ashima Garg

Research Scholar, University School of Applied Management, Punjabi University, Patiala.

Abstract- The present paper is based on the objective of impact of ICT on small scale Industrial Units of India. An attempt to discuss the different challenges in the sector and overcoming them to make the Small Scale Industries competitive. SMEs play a central role in the overall growth of the industrial economy of the country. Rather, Small and medium Enterprises in India are known as the backbone of the economy. The reason behind is that these enterprises are employing about 40% of India's workforce and contributing 45% to India's manufacturing output, they play a significant role in generating millions of jobs, especially at the low-skill level. The country's 1.3 million SMEs account for 40% of India's total exports. The current scenario clearly states that the growth of our economy is impossible without the growth and development of these enterprises but these enterprises are far behind the large counterparts in the economy.

Index Terms- Information and Communication Technology, Small Scale Industry, Manufacturing Industries.

I. INTRODUCTION

Information Technology (IT) provides an opportunity for businesses to improve their efficiency and effectiveness, and even to gain competitive advantage. The Micro, Small and Medium Enterprise (MSME) sector constitute an important fragment of the Indian economy in terms of its contribution to the country's industrial production, exports, employment and creation of consumerist base (Nanjudappa, D.M.2002). But in India SME's lack competitiveness. Competitiveness describes the ability of Small-Scale Industries (SSIs) to generate income/output and Maintain employment levels in the face of domestic and global competition. Consequently, in the absence of competitiveness, SSIs may face the problem of sickness or closure (Narayana, 2004). India is one of the very few countries to have consistently supported small-scale enterprises in order to

promote greater employment and perhaps also a more egalitarian distribution of wealth. This led to the growth of small enterprises in terms of output, employment and exports. Since the time of independence, the small-scale sector in India has been a major contributor to country's Gross Domestic Product (GDP). Phrases such as 'lifeblood of the economy' are used by politicians to describe SMEs' contribution to the economic welfare of society. Small and medium business types are well-known for its strong roots and foundation. Through the experience and aid coming from the financial institutions, the small and medium enterprise can compete in both domestic and international market. Small and Medium Enterprises (SMEs) play a vital role for the growth of Indian economy by contributing 45% of industrial output, 40% of exports, creating 1.3 million jobs every year and produce more than 8000 quality products for the Indian and international markets. SME's contribution towards GDP in 2012 was around 22% which is expected to increase in 2012. There are approximately 30 million MSME Units in India and 12 million people are expected to join the workforce in the next three years. SMEs are the fountain head of several innovations in manufacturing and service sectors, which plays a major role in the supply chain of corporate and the PSUs. SMEs are now exposed to greater opportunities than ever for expansion and diversification across the sectors. . The sector is viewed as the strategic thrust for the future and one of the greatest agents of growth. The policy based changes; investments into the sector, globalization, and India's growth story have opened up several latent business opportunities in the sector. Small and medium enterprises (SMEs) have been the backbone of the Indian economy. In recent years the MSME sector has consistently registered higher growth rate as compared to the overall growth of the industrial sector. There exists several definitions of the term small and medium enterprises (SMEs), varying from country to country and varying between the sources reporting SME statistics.

Enterprise	Investment	
	Manufacturing Sector	Service Sector
Micro	Does not exceed twenty-five lakh rupees	Does not exceed ten lakh rupees
Small	More than twenty-five lakhs but less than five crore rupees	More than ten lakhs but less than two crore rupees
Medium	More than five crores but less than ten crore rupees	More than two crores but less than five crore rupees

The main focus is on exploring the opportunities that new technologies present to SMB with the purpose to usage of information technology for competitive advantages in both local and international markets. Firstly, the paper highlighted the concept of SMB and information access and their uses and secondly, described SMB in India and ICT infrastructure. Information technology is having a significant impact in sector of SMB, especially where industries are in decline or when unemployment levels are high. In developing countries, SMB development is drawing attention too and modern trends of businesses and information technology usages are taking place.

II. LITERATURE REVIEW

Gallouj (2002) classifies literature on service innovation into three main categories: (i) Technological approach, which takes into consideration the introduction and diffusion of new technologies into services, which may have improved their productivity and other performance; (ii) Service-orientated approach, which regards innovation in the manufacturing and service industries as being different, and emphasises the “peculiarity” of services related to, for example, non-technological innovation; and (iii) Integrative approach, which investigates the boundary between goods and services, and develops a framework to bridge the gap between them. Despite the different views of innovation in the service industries, one key agreement seems to have been reached, i.e. service innovation is deemed to be a crucial factor of competitiveness and growth of services (Hauknes, 1998). The present study, which looks into the question of how ICT and organisational change may jointly contribute to the superior performance of services, follows the technological approach (for example, see Sirilli and Evangelista, 1998; Soete and Miozzo, 1989), while also taking into account the importance of non-technological innovation, as emphasised in the service-orientated approach. Indeed, the heterogeneity of service activities (across industries) may matter in terms of how different services benefit differentially from innovation. This is why Soete and Miozzo found it necessary to extend Pavitt’s (1984) taxonomy of sectoral patterns of technical change by proposing a specific taxonomy for services, which seriously takes into account the heterogeneous characteristics across these industries. Pavitt’s taxonomy, which consists of Science-based, Specialised-suppliers, Scale-intensive and Supplied-dominated industries, places all services into one category (namely, Supplier-dominated). Based on trajectories of innovation in services, Soete and Miozzo’s taxonomy suggests that only some service industries are supplier-dominated, for example, health, education, public and social services. Two other groups are, in fact, technology-intensive, and these are Scale-intensive physical network industries and Information network industries (for example, wholesale, transport, communication, insurance and financial services), and Science-based and specialised supplier industries (for example, software and business services). micro and SMEs are major providers of new jobs (Audretsch et al., 2002), increasing understanding of the key determinants of their success is essential. It is understood that SMEs in pursuit of organizational goals do not adopt the marketing concept to the same extent as larger firms (Pollard and Jemicz, 2006), and that

marketing practice in SMEs is situation specific, and variable, regarding the levels of sophistication and effectiveness (Hill, 2001). “However, it is recognized that small firm owner - managers do engage in marketing, but that the form this marketing takes is not fully understood” (O’Donnell, 2004).

More recent research (Balabanis and Katsikea, 2003) has also reported a positive association between entrepreneurial orientation and export performance, though moderated by contextual variables such as organizational and environmental factors. Studies have shown that entrepreneurial orientation of the owner or manager has also been found to have a positive relationship with performance and competitiveness (Covin and Slevin, 1991; Entrialgo et al., 2001; Hult, Snow and Kandemir, 2003; Ibeh, 2004; Kickul and Gundry, 2002; Marino and Weaver, 2002; Wiklund, 1999). Kazem and van Der Heijden, (2006) have argued that a firm’s ownership, regardless of size or structure, is characterized by a particular entrepreneurial orientation, certain decision-making style, and by a set of operational strategies. As with larger companies, SMEs must generate sales to survive, but need to market their products to generate sales (Carson, 1993). SME growth stems from engaging in some form of marketing activity, which will focus on attaining and retaining competitive advantage by engaging in marketing practice, that addresses market share, market development, product promotion, product pricing, product differentiation and distribution (Carter and Tzokas, 1999). The marketing function in SMEs is hindered by constraints such as poor cash flow, lack of marketing expertise, business size and strategic customer-related problems (Doole et al., 2006).

III. OBJECTIVES OF THE STUDY

1. Finding out the factors of ICT which affects manufacturing Units of Small Scale Industries
2. To assess the role participate by the various player in the Small Scale Enterprises

The work done on the research paper is of exploratory nature. It endeavors to explore the problems associated with the 150 Small Scale Industrial Units in the sampling frame and explore the growth prospects of the industry. The secondary data was used as a framework for the research study; the primary data from the industry sources was collected primarily to know the literal nature and the quantum of the various parameters under the research study to authenticate and add-on the secondary data and to check its accuracy and significance. The information was collected through a face to face situation from the sampling frame and through ‘*non probability judgment sampling*’ method and the sectors chosen for the research were handicraft, textiles and the leather industry spanning the states of Himachal Pradesh, Punjab and Haryana because of the known contacts and the ease of the data availability from the Small Scale Industries.

IV. ANALYSIS AND FINDINGS

Effective use of ICT for productive purposes can make tremendous difference in competitiveness outcomes. Therefore this individual SME competitiveness amongst themselves might collectively translate into positive results for the national

economies i.e. more job creation, more revenue generation and overall country competitiveness.

According to the literature from Cameroon, there might be several factors that can explain this slow adoption of ICT in the countries manufacturing industry; however the following are just of the few factors leading to these unsuccessful results as far as ICT involvement is concerned in the country.

- Inappropriate telecommunication infrastructures
- Lack of knowledge of the potential of ICT to meet enterprises needs
- Cost of ICT Equipments are to high.

Analysis of previous researches done in the sector and drawing conclusions that it can be rightly said there should be a clear participation of the government. The roles to be participated by different players are discussed below:

Government: The government is the most important entity in the renewal of the Small Scale industry. It should create and develop a business friendly environment enabling Small Scale Industry to start exports or to strengthen the already exporting companies by checking the corruption that hinders the growth of Small Scale Industries. The government should adopt measures to improve SME's access to finance by providing credits to SMEs directly from state owned banks, liquidity incentives to commercial banks that provide loans to the sector, interest rate subsidies, guarantee programs, etc.

IMF: International Monetary Fund can help in the improvement of the SME finance programmes in the framework of existing inter-regional, regional and sub-regional trade agreements. Funded projects aimed at micro or macro levels in the sector can be highly helpful for the sector.

Private Sector: Clustering is a very important initiative to group the SMEs according to their specialty and make them compete at the international level. Lessons from the successful clusters and industrial districts like those in China, Italy and can be considered and executed in the sector. One important project which can be undertaken by the established large players in the country to stabilize and promote the SMEs can be the co-branding exercise. Most of the SME products are unbranded and the successful marketing entities in the industry can accommodate related SMEs in their marketing campaigns locally and globally. The concept is made mandatory recently and many organizations are associated with the society in form of education, health, development, etc in India in varying degrees. Initiatives targeted at the sector can be market oriented, employees oriented, society oriented like health awareness, child education etc or environment oriented like green initiatives which can be aimed at making the Indian MSME sector competitive.

Multilateral Financial Institution: There should be coordination between financial and non-financial support institutions so that the SMEs access the medium to long term finance at preferential interest rates and export development investment funds (EDIF) to improve the performance of SMEs at comparative low interest rates. The international community should also enhance SME export credit and long term finance under the new Basel II accord in lieu with the Bank for International Settlements (BIS) for industrial and MSME policies.

V. CONCLUSION

It is encouraging the development of SMB sector as a way to diversify Indian economy. Information technology usage in SMBs in India is finding fast usage too. ICT systems are one of the important organizational resources for the firms of manufacturing industry. Small and Medium Scale Enterprises should seriously invest in Information and communication Technology to improve its manufacturing capacity. The government and private sector can participate central role in supporting to enhance the relationship between the ICT and Small Scale Enterprises, It has to be understood that although they are some challenges related with the implementation of ICT in the manufacturing industry. A small business managed by leaders who understands the benefits of IT adoption will be able to take advantage of the promised benefits of IT adoption, including improved organizational efficiency and effectiveness. Large No of enterprises could not function properly and productively without the accomplishment of ICT which help in manufacture and information management in the new changing environment. The Small Scale Industry can fight internationally in precise function. Small Scale Industries can also associate themselves with Large Scale Industries or MNC in form of co-branding.

REFERENCES

- [1] Micro, Small & Medium Enterprises Development (MSMED) Act, 2006
- [2] Suhail M. Ghouse.(2013), "Export Competitiveness of India: Can MSMEs play the Role?", Journal of Information Science and Management, Vol.1(0), PP.1-16.
- [3] Sanjay D. Beley and Pravada S. Bhatarkar (2013), "The Role of Information Technology in Small and Medium Sized Business", International Journal of Scientific and Research Publications, Vol.3(2), PP.1-4.
- [4] Hicks, O.J. (1993): Management information systems, 3rd Edition, USA
- [5] Barnatt, Chr., 1994. The computers in Business Blueprints, Oxford: Blackwell Publishers.
- [6] Kaibori, Sh.(2001): Development of Small and Medium Sized Enterprises and Policy Support-Action "Guidelines for tomorrow for policy makers in transition countries, Economic and Social Research Institute.
- [7] Papows, J., 1998. Enterprise.com: Market Leadership in Information Age. London: Nicholas Brealey Publishing
- [8] Pollard, D. (2006): Promoting Learning Transfer. Developing SME Marketing Knowledge in the Dnepropetrovsk Oblast, Ukraine.
- [9] Mustafa, M. & Gashi, P. (2006): Biznesi i vogël dhe i mesëm, Prishtinë, Kosovë.
- [10] Ghatak (2008-2009), Annual Report. Ministry of Micro, Small and Medium Enterprises, www.msme.gov.in
- [11] Nash, J.F. (1988): Accounting information systems, 2nd Edition, PWS, Kent Publishing Company, Boston
- [12] [http://www.med.gov.nz/templates/page_10117.asap#%20knowledge%20society] october 2008.
- [13] ICT adoption among MSMEs in India: A survey with special focus on Online B2B marketplaces (2008) by Internet and Mobile Association of India (IAMAI) and eStatsIndia.com,http://iamai.in/Upload/Research/B2B_report_30.pdf
- [14] Report on Effect of Economic Slowdown on Employment in India (October-December, 2008), Ministry of Labour and Employment, Government of India, January, 2009, http://www.labourbureau.nic.in/Report_on_EOFEMP_Jan09.pdf
- [15] Final Results Third All India Census of Small Scale Industries 2001-2002, Ministry of Small and Medium Enterprises http://www.smallindustryindia.com/publications/books/fcensus.htm

- [16] Information for development, Vol. VI No. 9, September 2008
- [17] Innovation Changing the MSME Landscape, 2011. A CII Report by Pricewaterhouse Coopers; www.pwc.com/india
- [18] Jain, S.K. and Kapoor, M.C. (1996), "Export attitudes and behavior in India: a pilot study", Journal of Global Marketing, Vol. 10 No. 2, pp. 75-95.
- [19] Journal of Computing, Volume 2, Issue 5, May 2010, ISSN 2151-9617
- [20] Keegan, Warren J. (2002). Global Marketing Management. USA: Prentice Hall.
- [21] Leonidas C.Leonidou (2004), "An Analysis of the Barriers Hindering Small Business Export Development", Journal of Small Business Management 42(3), pp. 279-302

AUTHORS

First Author – Ankit Garg, Ph.D Research Scholar, Punjabi University Patiala, ankit68832@gmail.com

Second Author – Ashima Garg, Research Scholar, ashima_ashu201288@yahoo.co.in

The Impact of Total Quality Management Using Data Mining on the Integrated Innovation Management in Smart Education

Mahmoud A. Ramadan^{*}, Ahmed I. El Seddawy^{**}, Ahmed S. El Rawas^{***}

^{*} Arab Academy for Science, Technology & Maritime Transport, Marketing Department

^{**} Arab Academy for Science, Technology & Maritime Transport, BIS Department

^{***} Arab Academy for Science, Technology & Maritime Transport, Finance Department

Abstract- Today, some twenty-two of the world's elite twenty-five research universities are located in one country. [29] He adds that it is not surprising that research on innovation has gained importance, it has become essential to understand why and how certain enabling environments encourage innovation and help optimize its various benefits. Among other things, research can identify how knowledge translates into innovative action and how diversity can drive positive change. In addition, one of the ways in which universities assure quality and acquire recognition in their home countries and abroad is through accreditation and certification. So, universities seek quality certifications differentiate themselves from the many institutions that are offering degrees and diplomas which have become commodities in the market economy. [29] say that Higher education institutions, and the people who study, teach and do research in them, are urged to place their intellectual capacities at the service of society, in order to defend ethical values such as peace, justice, freedom, equality and solidarity. And add development addresses the areas which are absolutely central to the future of most higher education institution. Consequently, the changing context for quality assurance innovation performance and enhancement in education presents both an opportunity and a challenge because it offers the possibility of integrating sustainable development into all quality systems.

Index Terms- TQM, DM, IIM, CIT, HE, WLI, Innovation, HD, SHE, WIL

I. INTRODUCTION

Higher Education is more than being just the cherry on the cake of education systems; it is a vital part of any sustainable development strategy. Higher education not only empowers people for their role in society and therefore is of vital importance to promote the sustainable development of our global community. It provides also the highly skilled individuals necessary for every labor market such as teachers, doctors, civil servants, engineers, humanists, entrepreneurs, scientists, and many more. [29] Besides increasing competitiveness of new rapidly growing economies, [20] adds Higher Education is a major driver of the global knowledge-based economy, since economic competitiveness depends, on the long run, on the quality of human resources. Need to enhance knowledge transfer and foster innovation and creativity. In higher education, the

beginning of massification has deeply changed the traditional patterns of knowledge production, diffusion and application over the past two decades. In the wake of burgeoning enrolments from the 1970s to 1990s, demand has continued to rise and the world's student population could reach an estimated 150 million by [20]. This demand is varied in objective and scope, covering traditional academic and research based teaching and learning as well as specialized and more practically-oriented training. And Concerning the Universities, they are complex organizations with distinctive set of characteristics which have strong impact on culture of those institutions [20]. The race for the best: professors, researchers, students, international prizes and awards international rankings the centrality of research activities the quality of international partners creation of inter-university and international networks and the new hierarchy among universities. Therefore [25] say they are continually exploring new ways to foster graduates who possess a broad range of personal, social and professional capabilities. One such approach is evident in the spread of work-integrated learning 'WIL' practices which are gaining greater presence and propulsion within the higher education landscape. Within modernity, being an entrepreneurial university may be a necessity to survive; however, in [19] terms, there are options between 'soft entrepreneurialism', which emphasizes creativity and the public good, and 'hard entrepreneurialism', which is driven purely by the market and profit.

University leadership and management have major responsibilities to ensure that university governance accounts for resources, policies and infrastructure to support students, staff, industry partners and the diverse WIL contexts of social justice, cultural diversity, technological advancement and uptake, internationalization and professional accreditation commitments. In higher education, these include: (i) demand; (ii) diversification of provision; (iii) changing lifelong learning needs; and (iv) growing Communication and Information Technology 'CIT' usage and enhanced networking and social engagement, both with the economic sector and with the community at large.

In higher education systems, this paper is aimed that offering sustainability of superior quality education among the most important goals for university strives to achieve using suitable proposed system. Moreover the purpose of this study is to increase the degree of quality performance and innovation management awareness, practice; As a result, in this paper it is mentioned about relationship between work-integrated learning

'WIL' and total quality management integrated innovation and, for the sustainability of higher education.

II. THE INTEGRATION BETWEEN TQM AND IIM

The quality tools that were used explicitly in the management of innovation processes, and will continue with a description of the quality tools that were primarily used for the management of quality, but unintentionally contributed to the management of innovation and they explained that many tools in strategic quality management, which are theoretically supportive to the management of innovation, actually do support the management of innovation to improve both the environment and their own competitiveness. At the same time, institutions of higher education are exploring means to integrate sustainability into curricula. And [25] list some the obstacles of the sustainable development of the higher education are following:

- Low efficiency of the HE system
- Long over duration of studies
- High dropout rates
- Lack of flexibility of study programs
- Recognition problems even within Europe
- Increasing social needs of an ageing population
- Adverse demography
- Slowdown of economic performance
- Public investment did not match the increase in number of students

In attempting to integrate sustainable higher education 'SHE', it is also necessary to address the focus; that is, a narrower or discipline-specific focus, or a broader or more cross-disciplinary focus. For example, sustainability can be integrated into higher education with a narrower focus, with respect to an individual program or school. Sustainability can also be integrated into higher education with a broader focus, with respect to cross-disciplinary or university-wide requirements. The generic matrix of options for integrating SHE is shown in figure 1 [18].

		SHE delivery	
		Existing structures	New structures
SHE focus	Narrow (discipline-specific)	I. Integrate into existing course(s) minor(s), major(s), or programs(s)	II. Create new, discipline-specific sustainability course(s), minor(s), major(s) or programs(s)
	Broad (cross-disciplinary)	III. Integrate into common core requirements	IV. Create new, cross-disciplinary sustainability course(s), minor(s), major(s), or programs(s)

Figure 1: General matrix to integrate SHE

- The upper left quadrant or Quadrant 1 represents integration of SHE within existing structures and through a narrower, more discipline-specific focus. Illustrations of this type of decision include integrating sustainability into an already existing course in management as a new topic, case or module [15].
- The lower left quadrant or Quadrant 3 represents integration of SHE within existing structures, but through a broader, cross-disciplinary focus. Illustrations of this type of decision include integrating sustainability into one or more common core course requirements across the university [15].
- The upper right quadrant, or Quadrant 2, represents integration of SHE through a narrower, more discipline-specific focus, but through creating a new structure [15].

III. THE PERCEPTIVE OF THE INTEGRATED INNOVATION MANAGEMENT AND THE HD

Innovation is key in today's economy. Managing Innovation and New Product Development (NPD) processes is key to the delivery of higher quality and more creative solutions. Bringing new solutions to market on time and within budget requires the best tools available in Innovation Management. Innovations result from ideas, if they are implemented in new products, services and processes, which find real usage and thus penetrate the market [17].

(Innovation = Ideas+ New P/S+ market imp)

And [] adds that, Innovations don't always have to be completely new ideas. The term innovation rather means the implementation of something new and results in a noticeable improvement for the user.

They are characterized by a special characteristic, clear originality and a noticeable user benefit. Innovations are as a result qualitative new products, services, processes, structures, markets and cultures. And according to despite global uniformity in many areas of society, there exists no single answer as to what constitute the most appropriate systems, structures or policies for higher education, research and innovation. Systems of innovation may have varied scope international, regional, national or local and may have different organizational and institutional components: Organizations are formal structures that are consciously created with an explicit purpose, and are thus the principal players involved. And Institutions can be defined as frameworks of norms, rules, legislation and routines which constitute the rules of the game [17].

IV. THE TOOLS AND MODELS FOR DEVELOPING SUSTAINABLE HIGHER EDUCATION

There are different tools can used to develop sustainable higher education to improve. And will proposed model to improve the efficiency of TQM in universities to maximize integrated innovation management.

4.1. The Auditing Instrument for Sustainability in Higher Education (AISHE):

New tools have been developed for higher education; one of these tools is AISHE, Auditing Instrument for Sustainability in

higher education developed in the Netherlands by the Dutch Committee on sustainable higher education. The Auditing Instrument for Sustainability in Higher Education 'AISHE' is an instrument designed to assess the level of integration of sustainability in higher education institutions. AISHE is based on a model for quality management developed by the European Foundation for Quality Management 'EFQM', and enhanced by the Dutch Institute for Quality Management 'INK' for commercial use in companies.

This EFQM-INK model starts from the idea that, based on a set of criteria, an organization is situated in a certain development stage: (1) activity oriented, (2) process oriented, (3) system oriented, (4) chain oriented and (5) society oriented []. Point out that the instrument can only be used in small groups on the level of single study programs, and the results may be biased by the subjective experiences of participants or the auditor's competences.

Table 1 gives an overview of different strengths and weaknesses of AISHE. Thus the evaluation of AISHE has led to the development of a new version of the instrument: AISHE 2.0, as a modular tool for each of the four roles of a university: education, research, outreach and operations. In order to achieve a holistic view, a fifth module is developed, the identity module.

Table 1: Strengths and weaknesses of AISHE

4.2. Learning and innovation frame work

Since 1996, the institution has developed and implemented two environmental plans, which have integrated research, education and operations in a comprehensive strategy. These plans are based on the model described in figure 2, which underlines the outputs that come from these three areas SD trained education professionals, SD solutions for research, and a SD role model for campus operations together with the flows that cross between them, which are synergetic effects that also have to be promoted. The balanced progress in the three areas provides mutual reinforcement for achieving the overall objectives of sustainable development in the university, as shown in figure 2 [13].

	Strengths	Weaknesses
Structure	<ul style="list-style-type: none"> EFQM Process oriented Flexible framework to use on an institutional level 	<ul style="list-style-type: none"> High level of complexity and abstraction Focus on single study programs Operations, research and outreach are underexposed
Process	<ul style="list-style-type: none"> Interactive Involvement of different stakeholders Raise awareness, "aha-erlebnis" Formulate desired situation 	<ul style="list-style-type: none"> Only usable in small groups Motivation not always included Emphasis on communicative aspects "Light-initiatives" are not included
Results	<ul style="list-style-type: none"> Define objectives and priorities Easy to understand and interpret the results Attractive and useful for decision makers 	<ul style="list-style-type: none"> Results depend on subjective experiences of stakeholders Results depend on the auditor competence No real indicators

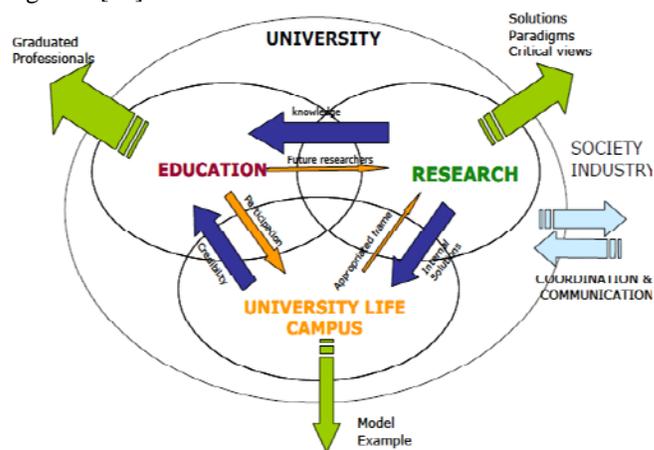


Figure 2: The role of UPC with respect to the environment and SD

V. THE PROPOSED MODEL FOR HIGHER EDUCATION USING TQM

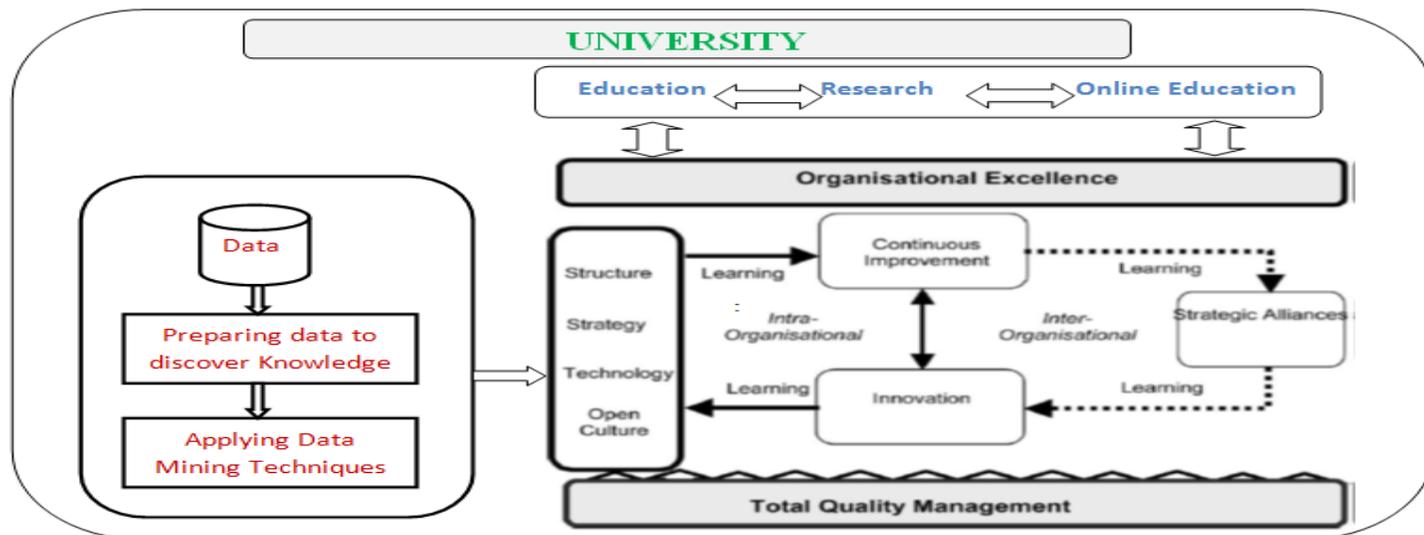


Figure 3: The Proposed Model Using Data Mining

Our proposed system called Higher Educational Data Mining System ‘HEDMS’ concerns with developing methods that discover knowledge from data and usage come from educational system. The objective of HEDMS is to build a DM system for organizations for education system and aim to improve the integrated innovation management in higher education using TQM.

HEDMS consists of several components; data gathering, preparing data to discover knowledge, data pre-processing, using data mining techniques in sequences steps start with classification data, clustering data especially using K-mean ‘K-M’ algorithm and enhanced K-mean ‘E-K-M’ algorithm to set which best result, then post processing and finally get result and visualize result to create best decision to take a good decision for organization. HEDMS Shown in figure 2.

The proposed system will describe and mining higher education data to apply the best solution for improve the integrated innovation management using DM techniques such as classification, clustering, association rule mining and visualization of data.

Hardware for applying the HEDMS is a personal computer configurations with this Processor 3.2, Hard Disk 160 gaga, Ram 2 G and Monitor 17 Inch. Operating system is windows XP services pack 3. Several software tools have been used. The first is Microsoft Excel sheets 2007 and has been used for analysis and filtering data. Mat-lab version 6.5 has been used in data pre-processing and data classification. The last software is the WEKA which is a collection of java tools for DM written by staff at the University of Waikato, New Zealand.

The proposed system HEDMS using higher technologies to improve the integrated innovation management in higher education, by TQM of educational systems and after investigating the result for proposed system can support university with information to make decisions about education systems in order to improve the students’ learning.

VI. CONCLUSION

Learning for sustainable development can be described as a joint search of individuals and organizations for knowledge and competence that enable them to deal with dilemmas in complex societal settings. That type of learning asks for authentic and open learning environments in which encounters with a diversity of disciplinary and stakeholder perspectives can take place. Most learning environments in traditional formal education do not optimally support that type of learning. Learning for sustainable development therefore constitutes a trigger for innovations in education.

In addition that quality management of innovation 'appears to be a subset of `innovation management 'that contributes sometimes explicitly, and in most cases implicitly, to the development of innovations. To improve quality in higher education truly contribute to sustainable development it is necessary that those running universities acquire an articulated vision of development. Where development is focused on their sustainability will be provided by making the necessary changes in future periods. In addition, conclude that Tools in strategic quality management do support the management of innovation. Creating the organizational conditions in which innovations can be developed; supervising and initiating innovation processes; producing innovation content; and implementing innovations in the primary processes of the organization.

On the other hand, if the focus of universities is not the formation of character and teaching people how to think deeper and broader than they so far have then they will produce individuals who can do things but incapable of dealing with all the major aspects of human existence Therefore according to EUROPEAN, If the business idea and/or innovation is developed inside the university, there will be basic problems as to intellectual property rights and to teachers’ role as civil servants in some countries the law prevents teachers and researchers from

a working as entrepreneurs and exploiting innovations developed in the course of their work.

The greater the commitment to integrate sustainability into the curricula -in terms of more and/or new structures, and broader focus – the greater is the need for faculty resources and training in sustainability, as well as rewards for engaging in sustainability education and research. Furthermore, employers and students must understand how the systems of which they are a part social, economic, and ecological function and are integrated. In order to accomplish this we need a significant segment of the learning opportunities for students to be structured to accomplish these outcomes. To do so will require significant changes in the curriculum and the pedagogy used to deliver that curriculum. These changes will only occur when large numbers of faculty have the knowledge, skills, resources, support, incentives, and disposition to change what and how they teach.

We have described how different data mining techniques can be used in order to improve the students' learning by supporting decision of teacher. All these techniques can be applied separately in a same system or together in a hybrid system. Although we have described the most general and well-known data mining techniques, there are as well other specific data mining techniques that are also used in e-learning such as classification, clustering and association rules. This technique is used for data cleansing, spotting emerging trends and recognizing unusually good or bad performers of students. In e-learning, outlier detection can be used for assisting instruction in the detection of learners' irregular learning processes. There are several benefits for HEDMS will effect on TQM such as;

- Facilitating critical conversations around the goals, objectives, student learning outcomes, underpinnings, and nomenclature surrounding;
- Developing partnership opportunities for collaborations to develop focused initiatives supporting sustainability education;
- Sharing opportunities for collaboration on ongoing projects and programs;
- Helping funding agencies and foundations better understand sustainability education and its significant role in improving higher education;
- Convening academic leaders for EfS discussion; and
- Identifying additional leverage points for forwarding the sustainability education agenda.

VII. FUTURE WORK

The future work will divide to tow steps of implementations; first focused on how we could develop the proposed approach and enhancing the approach by using DM classification technique to provide the universities best result and support high level of management with a good decision to increase the efficiency of TQM. Second focused on measuring this impact on TQM and the integrated innovation management in higher education

In the future, one of UPC's clearest goals is to improve its interaction with all stakeholders. Therefore, UPC will benefit from the outside worlds' interest in SD by developing a clear and

efficient interface for stakeholders who clearly express their interest in collaborating with UPC in greater depth.

REFERENCES

- [1] Merceron, A. and Yacef, K., 2013, "Interestingness Measures for Association Rules in Educational Data". Proceedings of the first International Conference on Educational Data Mining, Canada, pp. 35-41.
- [2] Merceron, A. and Yacef, K., 2009, "Educational Data Mining: a Case Study, School of Information Technologies, University of Sydney", Australia, Vol. 11, No. 5.
- [3] Han, J. and Kamber, M., 2001, "Data mining: concepts and techniques", San Francisco, Morgan Kaufman.
- [4] Merceron, A. and Yacef, K., 2004. "Mining Student Data Captured from a Web-Based Tutoring Tool: Initial Exploration and Results", Journal of Interactive Learning Research (JILR), Vol.15, No.4, pp. 319-346.
- [5] Herin, D., Sala, M. and Pompidor, P., 2002, "Evaluating and Revising Courses from Web Resources Educational", In Int. Conf. on Intelligent Tutoring Systems, Spain, pp. 208-218.
- [6] Chen, Han, and Yu. 1996. "Knowledge and Data Engineering Data mining: An overview from a database perspective", IEEE Trans, Vol. 30, No.3, pp. 8:866-883.
- [7] Fayyad U., Piatetsky G. and Frawley W. J, 1991. "Press definition of KDD at KDD96". Knowledge Discovery in Databases, AAAI/MIT, Vol. 30, No.3, pp. 8:866-883.
- [8] Gartner, February 2000, "Evolution of data mining", Gartner Group Advanced Technologies and Applications Research Note.
- [9] Turban, E., Aronson J., Liang T. and Sharda R, 2007, "Decision Support and Business Intelligence Systems", eighth edition. Prentice Hall.
- [10] Mostow, J., Beck, J., Cen, H., Cuneo, A., Gouvea, E., and Heiner, C., 2013, "An Educational Data Mining Tool to Browse Tutor-Student Interactions: Time Will tell", in: Proceedings of the Workshop on Educational Data Mining, pp.15-22.
- [11] Mohammad H. and Jafar H, September, 2011. "Using Educational Data Mining Methods to Study the Impact of Virtual Classroom in E-Learning", IJDKP.
- [12] Gabrijela D. and Dragana P. September, 2011, "The Use of Data Mining Methods For Analyzing And Evaluating Course Quality In The Moodle System", IJDKP, Vol. 47, No.3, pp. 17-27.
- [13] Sonali A., Pandey G. and Tiwari M., 2010. "Data Mining In Education: Data Classification and Decision Tree Approach" Vol. 11, No. 5.
- [14] Félix C., Alfredo V., Àngela N. and Francisco M., 2010, "Applying Data Mining Techniques to E-Learning Problems" Vol. 2, No. 6.
- [15] Mamcenko, J., Sileikiene, I., 2013, "Analysis of E-exam Data using Data Mining Techniques", Vol. 10, No.7.
- [16] Khedr, A. Elsayed, "Towards Three Dimensional Analyses for Applying E-Learning Evaluation Model: The Case of E-Learning in Helwan University", International Journal of Computer Science Issues (IJCSI), Vol.9: Issue: 4: No.1, July 2012, Pp.161-166.
- [17] Amira M. Idrees, Ayman E. Khedr and Ahmed I. El Seddawy, 2014, "Performance Tuning of K-Mean Clustering Algorithm a Step towards Efficient DSS ", Vol. 2, No. 6.
- [18] EUROPEAN COMMISSION, 2008. Enterprise and industry directorate-general promotion of smes competitiveness entrepreneurship best procedure project: entrepreneurship in higher education, especially in non-business studies! final report of the expert group
- [19] Lambrechts, Ceulemans, 2011, Wim Lambrechts, Kim Ceulemans AUGUSTUS 2011, —Sustainability in Higher Education: Experiences using the Auditing, Instrument for Sustainability in Higher Education! (AISHE), HUB RESEARCH PAPER 2011/11.
- [20] Nazaré, 2008, 30th annual EAIR forum , Copenhagen, 24 – 27 August 2008, Globalisation: Challenges and opportunities for higher education, Maria Helena Nazaré ,Universidade de Aveiro, Portugal Þorsteinsson 2010, Internationalization in higher education , Annual Nova seminar 2010 , Selfoss Iceland Björn Þorsteinsson, Agricultural University of Iceland, en: Lund University.
- [21] A.D. Cortese, 2003, the critical role of higher education in creating a sustainable future, Planning for Higher Education, 31 (3), 15-22.

- [22] AASHE, 2010, Sustainability Curriculum in Higher Education ,A Call to Action —Association for the Advancement of Sustainability in Higher Educationl ,1536 Wynkoop Street Suite B500, Denver, CO 80202 • Phone: 303.605.3537 • www.aashe.org
- [23] Andy Johnston March,2007.HIGHER EDUCATION FOR SUSTAINABLE DEVELOPMENT Final Report of International Action Research Project
- [24] R. Lozano, (2006a). Incorporation and institutionalization of SD into universities: breaking through barriers to change, *Journal of Cleaner Production*, 14, 787-796.
- [25] Rands G., (2009), —A principle-attribute matrix for sustainable management education and its application: the case for change-oriented service-learning projects!, *Journal of Management Education*, Vol. 33 No. 3, pp. 296-322.Research and Knowledge/ International Centre for Higher Education Research Kassel at the University of Kassel
- [26] Roorda N., (2010). Sailing on the winds of change. The Odyssey to Sustainability of the Universities of Applied Sciences in the Netherlands. PhD thesis, Maastricht University.
- [27] Ross L. Chapman, Peter Charles Murray and Robert Mellor ,March 1996, —Strategic quality management and financial performance indicators!,InCITe (Innovation & Continuous Improvement Technologies) Research Group, University of Western Sydney, Macarthur, Campbe lltown, Australia
- [28] Scott Leavengood and Timothy R. Anderson 2010, Best Practices in Quality Management for Innovation Performancel. Proceedings of the International Convention of Society of Wood Science and Technology and United Nations Economic Commission for Europe – Timber Committee October 11-14, 2010, Geneva, Switzerland Paper WS-48 1 of 9
- [29] Scott Leavengood and Timothy R. Anderson, Spring 2011,|Quality + Innovation Adapting Quality Management Practices to Achieve Innovation Performance, *Engineered Wood Journal* •
- [30] Shelly F. Fust & Lisa L. Walker 2007 ,I CORPORATE SUSTAINABILITY INITIATIVES: THE NEXT TQM?!, Understanding emerging corporate sustainability practices through the lens of total quality management ,Copyright 2007 Korn/Ferry International
- [31] Siemer, S., Elmer, S. en Rammel, C. ,2006, Pilot study: Indicators of an education for sustainable development. FORUM Umweltbildung, Wenen Shriberg, M., 2004, Assessing sustainability: criteria, tools and implications, in: Corcoran, P.B. en Wals, A. Higher education and the challenge of sustainability. Problematic, Promise and Practice. Kluwer Academic Publishers, Dordrecht/Boston/London, 71-86.
- [32] Simpson, M., 2011, A 'one university' approach to ongoing quality enhancement, student satisfaction and risk minimization in workplace learning across geographically remote campuses of an Australian university. Paper presented at WACE Conference June 14-17, 2011, Philadelphia, USA.
- [33] Steen, M. & Dhondt, S. (2010). Slow innovation. Paper presented at European Group for Organizational Studies Colloquium, Lisbon, 1-3 July 2010.
- [34] Stengers, I. 2011, Another science is possible!! A plea for slow science. Faculté de Philosophie et Lettres, ULB 13 December 2011, Inaugural lecture: Chair Willy Calewaert 2011-2012 (VUB).
- [35] STREBEL, H. UND HASLER, A. (2007): Innovations- und Technologies management 2007.
- [36] TAGWERKER-STURM, M. (2010): Innovations controlling, 09.12.2010.
- [37] Teresa Swirsk, 2012, Re-Imagining Work-Integrated Learning Through Slow Innovation In Higher Education, Maree Donna Simpson Charles Sturt University, Australia, *Asia-Pacific Journal Of Cooperative Education*, 2012, 13(4), 239-253 UNESCO Forum on Knowledge Systems
- [38] V. Lynn Meek ,Ulrich Teichler, Mary-Louise Kearney, [Olsson and Mkandawire,2009] Berit Olsson and Thandika Mkandawire, Chapter 2 Compelling Rationale for a Copyright © 2009 UNESCO Forum on Higher Education
- [39] Z. Irani , A. Beskese , P.E.D. Love, Total quality management and corporate culture: constructs of organizational excellence *Technovation* 24 (2004) 643–650.

AUTHORS

First Author – Mahmoud A. Ramadan, Arab Academy for Science, Technology & Maritime Transport, Marketing Department, Mahmoud.Ahmady@aast.edu

Second Author – Ahmed I. El Seddawy, Arab Academy for Science, Technology & Maritime Transport, BIS Department, Ahmed.AISeddawy@aast.edu

Third Author – Ahmed S. El Rawas, Arab Academy for Science, Technology & Maritime Transport, Finance Department, AhmedAIRawas@aast.edu

Business' Students Industrial Training: Performance and Employment Opportunity

Erni bte Tanius

Faculty of Business, University Selangor, Shah Alam, Selangor, Malaysia

Abstract- Industrial training program refers to the experience obtains in the real working environment that has been identified as part of aid to prospective employment. This paper reports the perception of 187 industrial supervisors on the 307 business students' performance and their employment opportunity during industrial training. The results show that the students' performances are excellent in the areas punctuality, honesty, teamwork, and relations with colleagues. However, there is a sign of lacking in the job related skills such as the ability to identify and formulate the job problems, efficiency in completing task as well as knowledge of current development related to task/job. In term of employment opportunity is high to medium. As an implication, the equal partnerships between university and employers are crucial to increase students' employability skills and employment opportunity.

Index Terms- Industrial Training, Interpersonal Skills, knowledge and technical skill, Soft Skills, Employment opportunity

I. INTRODUCTION

Industrial training is a significant method for combining theoretical education and practical working world. Tovey (2001) stated that the industrial trainings are not only a benefit for the students but also a kind of mutual benefits for both students and industries. Industrial training really does benefit industries, like inexpensive sources of competent assistance, highly motivated present employees, and the chance to cultivate prospective employees (Coco, 2000). Often jobs are readily available, but the graduates lack what is needed to get and keep jobs. As such, it is crucial to study the employer perception on skills and standard of students that they perceived performed, so higher learning institutions may restructure their syllabus that match with need of industry.

Malaysia is now said to be at the mid-point in its journey towards Vision 2020 and is transforming to become a developed nation. To be recognized as an economically developed country Malaysia needs to restructure its workforce by having highly skilled workers that has to be able to cope with the changing nature and demands of works. Currently Malaysia still faces problems on high unemployment rate among graduate. Survey discovered on 2008 about 60,000 Malaysian Graduates were unemployed due to a lack of experience, poor English, poor communication skills and because they had pursued studies irrelevant to the market place. As the result, their employment opportunity is low and employer having similar problems in getting employees that match with their needs. Therefore, it is the

duty of higher learning institutions to ensure that their students are well-equipped with employability skills and give them expose to industry through industrial training.

This paper would like to identify the industrial perception on business students' performance during the practical training and their employment opportunity. More specifically, this paper attempts to investigate if the undergraduates' core competencies are able to meet with the requirements set by the employers.

This study focuses in a private university in Malaysia. Currently this university has more 83 programs range from foundation to post graduate programs. Industrial training is compulsory for all diploma and bachelor students. The sample of the study is students from Faculty of Business (FOB) with five programmes involve, they are Bachelor of Accountancy (BOA), Bachelor of Finance (BOF), Bachelor of Marketing (BOM), Bachelor of Business Management (BBM) and Bachelor in Industrial Management (BIM).

II. OBJECTIVES OF THE STUDY

The objective of study are to identify the industrial's perception on performance of business' students during industrial training and to identify the employment opportunity of UNISEL business' students during industrial training.

Previous research shows that internship will give benefits to both organization and student. Organization most valued on their interns was communications; knowledge of the host organization, its structure, function and purpose; flexibility and fulfilling requirements above and beyond the necessary standard (Adam J. 2007). Meanwhile Callanan G. and Benzing C. (2004) showed that an internship was linked with finding career-oriented employment and securing career-oriented employment at the time of graduation, gain valuable real-world experiences (Neuman, 1999), acquire additional expertise and confidence in the specific area that they expect to target when they seek permanent jobs. Finally, Beenen G. (2008) student appears to be more satisfied, and more likely to both receive and accept job offers. Study done Hodges D and Burchell N. (2003) revealed that 79% of employers considered that it was important for graduates entering business roles to have some business work experience prior to completing their tertiary study and they want graduates to be more 'work-ready'

Meanwhile, Lam, T., & Ching, L. (2007) said industrial training can assist students to bridge the gap between the academic learning process and the practical reality. According to Cannon, J. A., & Arnold, M. J. (1998), internship may pave the way for permanent employment upon graduation as well as providing an in-depth understanding of actual business practice.

Industrial training able to give students benefit such as improvements in career-related direction, gaining practical experience, improved marketability of graduates, job expectations, interpersonal skills, leadership and understanding of the business applications of classroom learning (Muhamad, Rusnah, et al. 2009). Personal and interpersonal skills are characteristics and “soft people skills” that relate to attitudes and behaviour toward work (commitment to quality and efficiency), that include integrity and ethics, and the ability to attract others to your well-seasoned and logical point of view (Siam, John J. 2005).

Previous study on industrial found out that event though mainly employer satisfied with the performance of students but there are some areas need improvement. Gunadevi K. Jeevi Subramaniam and Raja Nor Safinas Raja Harun (2013) revealed that employers found that the internship’ students lacking in public speaking in particular when dealing with customers and they put emphasis on the importance of communicating with customers in English. Nurliana M.A (2013) study on pharmacy students, found out that 82% of students performance is excellent during industrial training but still need improvement on entrepreneurial and managerial skills. Finally, Nor’ Aini Yusof, et al (2013) study on 179 employers, indicated a satisfactory level of students’ performance during the training. Most employers were willing to recruit the students in future. Technical skills were ranked as needing the most improvement by students.

In summary, past research has viewed industrial training as a positive developmental experience for university students and proved with some favorable outcomes as improved ability to secure a career-oriented position. Previous study also shows that

still many areas need to improve in order to increase the students employment opportunity. This study will study in depth skills that employers perceive lacking on the students during industrial training.

III. RESEARCH METHOD

SAMPLE: 307 students from Faculty of Business and 187 organizations participated in this exercise. The study was carried out after they have completed their training. The students were from five courses, they are Bachelor of Accounting (BOA), Bachelor in Business Management (BBM), Bachelor of Marketing (BOM), Bachelor of Finance (BOF), and Bachelor of Industrial Management (BIM). **TOOLS:** evaluation of student’s performance by industrial supervisor; ‘interpersonal skills’, ‘knowledge & technical skills’ and ‘soft skills’ that represent 18 different attributes. SPSS 16.0 is used to analyze the data by using SPSS 16.0.

IV. RESULTS AND DISCUSSION

Respondents Background. As shown at table 1, almost two third or 79.68% students were practical in private sectors and mainly they are female (79%). In terms of race majority is Malay (63.2%) and they are from BIM (31.27%), next BBM (26.06%) follow by BOF (23.45%), BOM (13.03%) finally from BOA (6.19%).

Table 1: Respondents Background

Placement	N	%
Private	149	79.68
Government	38	20.32
Total	187	100.00

Gender	N	%
Female	242	79
Male	65	21
Total	307	100.00

Race	N	%
Malay	194	63.2
Indian	88	28.7
Chinese	10	3.3
Total	307	100.00

Programme	N	%
BIM	96	31.27
BBM	80	26.06
BOF	72	23.45
BOM	40	13.03
BOA	19	6.19
Total	307	100.00

Performance of Business Students during Practical Training. As the whole industrial supervisors satisfied with the performance of business students during industrial training, As shown in table 2; the 7 most skill rated as excellent and good by industrial supervisor, they are: punctuality (65%), team work

(60.9%), relation with colleagues (58.6%) and they also satisfied with students honesty, attitude, appearance and flexible/adaptable.

Table 2: Top 7 most perform skills by students during industrial training

N o.	Items	Good		Excellent	
		N	%	N	%
1	Punctuality	88	28.7	200	65.1
2	Team work	100	32.6	187	60.9
3	Relation with colleagues	114	37.1	180	58.6
4	Honesty	121	39.4	174	56.7
5	Attitude	125	40.7	162	52.8
6	Appearance	135	44	135	48.9
7	Flexible/adaptable	150	48.9	128	41.7

Even though result shows that organizations satisfied with students performance but on some areas especially in knowledge and technical skill and soft skills, organizations feel that students skill lacking as some of the students rated as satisfactory and below average. As shows in table 3 are the main 8 least perform skills by students during industrial training with the least skill is leadership (5.5%) students rated as below average and another

24.1% as satisfactory only. Mainly students were lacking on knowledge and technical skills, especially in the ability to identify and formulate the job problems, efficiency in completing task, product knowledge, and knowledge of current development related to task/job.

Table 3: Top 8 least perform skills by students during industrial training

No .	Items	Below average		Satisfactory	
		N	%	N	%
1	Leadership	17	5.5	74	24.1
2	Ability to work independently and proactive	9	2.9	48	15.6
3	Ability to identify and formulate the job problems	9	2.9	71	23.1
4	Product knowledge	8	2.6	78	25.4
5	Efficiency in completing task	6	2.0	42	13.7
6	Knowledge of current development related to task/job	5	1.6	65	21.2
7	Communication ability-written	5	1.6	49	16
8	Time management skill	5	1.6	47	15.3

Employment Opportunities. Result shows that employment opportunity for business students' is quite high, as shown in table 4 more than half (62,87%) of students hired after they finished they are practical training with most hired as full time staff (42.34 %) followed by students hired as a contract

staff (12.70%) and the least is student hired as part time staff. Students from students from BIM is the highest in term of employment opportunity (31.61%) followed by BBM students (24.35%), meanwhile the least students employ are from BOA (6.22%).

Table 4: Employment Opportunities by Program Attend

Employment Opportunities	Program Attend					Total
	BOA	BBM	BOM	BOF	BIM	
Hired as full time	10	28	19	28	45	130 (42.34%)
Hired as part time	0	5	0	0	2	7 (2.28%)
Hired as temporary	2	8	0	4	3	17 (5.54%)
Hired as contract	0	6	12	10	11	39 (12.70%)
Total	12 (6.22%)	47 (24.35%)	31 (16.06%)	42 (21.76%)	61 (31.61%)	193 (62.87%)
Not hired	7	33	9	30	35	114 (37.1%)

Base on above finding, it can conclude that as the whole, industrial supervisor satisfied with performance of business students' with excellent in the areas punctuality, honesty, teamwork, and relations with colleagues. It is as indicator that business students' accepted and their performance up to organizational standard but the study also indicated that students lacking in important skills, job related skills such as skills, in the ability to identify and formulate the job problems, efficiency in completing task, product knowledge, and knowledge of current development related to task/job and leadership. It is shows that students may have advance theoretical skills, but their practical skills are still weak. As for employment opportunity, even though more than half of student is hired but the number is still not encouraging.

The study results might also be helpful to academic institutions in the sense of better preparing students for business practical experiences by designing their courses of studies to be more practical. Case studies based on real-life examples should be incorporated in lectures and tutorials by means of classroom simulations and group work assignments. Taking advantage on the academic-industry cooperation practice, real cases at work could also be brought into lectures in order to enable the undergraduates to have a hands-on experience in tackling job task in their areas of studies at the real working world environment. The academic institution may invite expertise from industry to be industrial advisor as they can provide constructive feedback to the undergraduates as a means of sharpening their critical analytical skills, problem solving skills, decision making skills, oral communication skills, negotiating skills, and planning skills which are most sought after by employers nowadays.

REFERENCES

[1] Adam J. (2007) Employment and Engagement: Evaluating Art Industry Internships.
 [2] Beenen G. (2008), Exploring MBA Internship Effectiveness: Intern Goals and Outcomes, GMAC © Research Reports • RR-08-01 • February 7, 2008
 [3] Callanan G. and Benzeng C (2004), Assessing the Role of Internship in the Career-oriented Employment of Graduating College Students, Emerald, Volume 46. No 2 pg 82-89

[4] Cannon, J. A., & Arnold, M. J. (1998). Student expectations of collegiate internship programs in business: A 10-year update. *Journal of Education for Business*, 73(4), 202-205.
 [5] Coco, Malcolm. (2000). Internships: A Try Before You Buy Arrangement. *S.A.M. Advanced Management Journal*. Cincinnati, 65(2), 41-44.
 [6] Gunadevi K. Jeevi Subramaniam and Raja Nor Safinas Raja Harun (2013). The ability of the polytechnics marketing student in using good English oral communication skills during industrial training. *English for Specific Purposes World*, 14(39).
 [7] Hodges D and Burchell N. (2003), Business Graduate Competencies: Employers' Views on Importance and Performance, *Asia-Pacific Journal of Cooperative Education*, 2003, 4(2), 16-22.
 [8] Lam, T., & Ching, L. (2007). An exploratory study of an internship program: The case of Hong Kong students. *International Journal of Hospitality Management*, 26(2), 336-351.
 [9] Muhamad, Rusnah, et al. (2009) "Undergraduate internship attachment in accounting: the interns perspective." *International Education Studies* 2.4 : p49.
 [10] Nurliana M.A et. el.(2013), Bachelor of Pharmacy Industrial Training: Performance and Perceptor Perception, *International Research Journal of Pharmacy*, volume4 (5)
 [11] Nor' Aini Yusof, et al (2013) Improving Graduates' Employability Skills through Industrial Training: Suggestions from Employers, *Journal of Education and Practice* www.iiste.org, Vol.4, No.4, 2013.
 [12] Siam, John J. (2005)"University trading centres and their role in business education." *Journal of Financial Education*: 1-23.
 [13] Tovey, Janice. (2001). Building Connections between Industry and University: Implementing an Internship Program at a Regional University. *Technical Communication Quarterly*. St. Paul, 10(2), 255-239.

AUTHORS

First Author – Erni bte Tanius is a Lecturer at the Faculty of Business, University Selangor, Shah Alam, Selangor, Malaysia, She obtained her first degree in Econimics from Universiti Kebangsaan Malaysia, her Masters Degree from Universiti PUTRA Malaysia (Human Resource Development). She has more than 20 years of working experiece with the Industry as human resource practices before joining Universiti Selangor. Her current research studies are related to human resource, management and employee relations.

A Development Model Toward Social-Protection Policies for the Indonesian Women Migrant Contract Workers as Domestic Workers in Hong Kong

Hesti R.Wijaya*, Keppi Sukesti**, Henny Rosalinda***

Brawijaya University Post Graduate Program,
Magister Degree Course of Women Studies

Abstract - A social protection policy model is engineered for the Indonesian women workers migrating internationally for employment as house-maids in Hong Kong. At the work place, various kind of problems have been encountered. However, regardless vulnerabilities they faced, and the fact that their number is the highest among other migrant workers as such from other countries, hardly any social protection from the country of origin is available. Officially the protection policy of the Indonesian-government is supposedly provided by Law No. 39/2004 regarding placement and protection. However, most of its content is directed almost solely to placement issues. This research is aimed at a social protection model for the Indonesian migrant workers at the work-place, using research methodology for Women's Studies with feminist perspective. It is a qualitative study, based on grounded issues faced by the migrant women in Hong Kong, participatory, and it is action-oriented one. The findings indicate that in the work-place, the problems experienced by the women domestic-helpers have been ongoing at a wide range. To mention several are the impact of the authoritarian agents with respect to placement and objectification on women migrant workers, superior - inferior employer-employee relationship resulted in abusive violence against women workers, exploitation, sexual harassment, unilateral contract breaking by employers, unpaid labor and underpayment. A model toward social protection policies is conceptualized, based on the existing realities and challenges, which approach is bottom-up. Collective action by all stakeholders participated from all intuitions involved is a necessary conditions, in particular NGOs already provided social protection NGOs in various ways. In addition, the Women' Studies scientists from Indonesia as the sending country and Hong Kong as the academes ought to be involved be as facilitator and, or resource persons to make the conceptual model carried out in the near future.

Keywords: Indonesian migrant women workers, domestic-helpers/house-maid, social protection policies, social-engineering model for developing protection at the work place

I. Introduction

Along the line of gender ideology where women's roles are related to domestic work, women involve in income earning activities on this area. Women migrant workers overseas as domestic workers is not a new phenomena. Historically, only men working abroad as migrant workers. In Indonesia, almost four decades since early 70's, women have engaged in international migration in search of job. Countries such as Saudi Arabia, Malaysia, Singapore and

Hong Kong are the most popular country of destinations for the Indonesian women migrant workers. The income earned is higher than same kind of job in the home country. However their burdens are multiple, due to sole working place in the foreign receiving countries. Leaving their family left behind. As domestic helper abroad, the work is chores, and care works. The women bring their skill in domestic work to the public place across continents. As the workplace is invisible, coupled with gender ideology that women is subordinated, the magnitude of the problems receives little attention from scholars. In December 2013 Migrant Workers International Conference in Hong Kong, no one else presented papers about the plight of migrant women as domestic workers. Only very recently their issues attracted attention of scientists.

Worldwide, overseas migrant contract workers have been originated from almost all continents including Asia (Anggraeny, 2006; Kaur & Metcalfe, 2006), Asia Pacific (Iredale, 2009), Latin America (Bendixen & Onge, 2005) and Europe (Morisson et al, 2008). In Asia, countries recruited these women include Taiwan (Chia Lan, 2008), Hong Kong (Constable, 2007) and United Arab Emirate (Irianto, 2011). For the Indonesians, neighboring country namely Singapore and Malaysia, and Arab Saudi as the origin of Islamic religion, are popular Asian destination countries. Other sending countries are Morocco, Africa (De Haas, 2007), El Salvador, Latin America (Gammage, 2008), Tajikistan, Central Asia (Kireyev, 2006), Turkey, Asia Minor (Koc & Onan (2004), Mexico, Central America (Mishra, 2007), Philippines, Southeast Asia (Semyonov & Gorodzeisky, 2005), and Nepal, South Asia (Theme & Wyss, 2005). By all means this is not an exhaustive list.

Various problems and challenges observed in the receiving countries where women migrant workers are employed as house-maids worth studying. The existing work of scholars are varied from descriptive studies (Bohning, 1984), identification of the enemies of migration (Cohen, 2008), establishing theory of migration and development, and the most popular is about remittances. Due to its popularity, remittances issues is described in the next section.

Scientific research problem concerning the women's migrants issues in the work place is limited, while the state policies to protect the citizens employed abroad is scanty. As for Indonesia, surprisingly, despite media attention that frequently blows the various incidences of human rights violation ranging from verbal abuse, physical violence, breaking labor laws, under-payment, excessive labor employment-cost, in-termination, rape, death, to mention a few, scholarly writing related to the Indonesian women's situation in the work place is lacking. Their problems and issues in the work place too, is hardly available. This research

paper is a report in response to this problem. The research work focuses on the problems encountered, and searching problem solving to unshed the grey area of the women workers plight in Hong Kong as the foreign receiving country. The main research questions are two folds:

1. What are the problems encountered in the work place?
2. What are the protection available to the migran women?

The ultimate goal of this research work is the protection of the Indonesian migrant women working as house-maids in Hong Kong. Although this research paper is only a preliminary attempt of this endeavour is considered important to meet the urgent needs of social protection.

II. Research Elaborations

Despite the sufferings of the women migrant workers in the receiving countries, the most popular work among scholars for so long is dealing with remittance only. Their interests are well taken by the executives government from the sending countries. The Philippines has been the first country appreciating the women workers who work overseas as heroin's. In Indonesia too, following a significant contribution of the migrant women workers in the form of remittance that greatly noted during the economic crisis at the turn of the 21st century the term *Pahlawan Devisa* (the countries' foreign-currency income heroin) is popularised nation wide. Again, lack of gender perspective the interestof the Government is merely limited to monetary economics, while their situation and conditions in the workplace are ignored.

1. Against the odds: Remittance, the main interests of worldwide economists on migrant workers

A straight forward understanding about the monetary economic mind-set of the conventional economists with respect to the international women migrant workers is due to the gender blindness of the scientists. They have neither gender awareness, nor gender sensitivity on the gender issues faced by the women migrant workers. Consequently, without any gender perspective, their focus and their issue of interest is almost solely regarding remittances. Although the topic is, by and large, limited to one point of interest namely remittance, the existing work of the researchers and writers covers various perspectives, such as from macro-economy to micro-economy, from country level, to international perspectives. The works of Adams & Page (2005) for example, examine the capacity of remittance to reduce poverty. Relating remittance and development is popular work among scholars (Gosh, 2006), who search the impact of remittance on development. It has been concluded that expectation that remittance having impact to boost a country's development is merely a myth. In the meantime, psychologically the altruism of the women workers sending remittance to the home country is questionable. Working on this area, Poirine (2006) researching to find the answers through her study on identification of any sign concerning the increasing magnitude of remittance in the Asia-Pacific countries. As mentioned above, the Indonesian government also greatly valued remittances send by the women migrant workers to the home country. Gloryfication of women migrant workers suddenly during the on-going economic crises recently, was a real opposite from what used to be a women work as domestic helper has been perceived with no prestigious perceive informal work, unskilled one, as embarrassing job for the country, as foreign-currencies heroine (*Pahlawan Devisa*) has been blown in official speeches, billboard, electronic media, radios and news papers. This is a

real opposite from years back shameful and embarrassment due to what is considered unrespectable job engaged as house-maids.

As far as the total amount of remittance obtained, there is no official figures release by the Department of Finance, or the Central Bank of Indonesia. By the turn of the century, in year 2,000, it has been news released that the foreign currency contributed to the country is USD 13 billions, equivalent to 2% of the APBN (*Anggaran Pendapatan dan Belanja Negara* or, in English, the Annual State Income and Proposed Budget). At the macro level it seems a huge amount, but for the migrant women individually, their remittances are difficult indeed to make it sustainable (Arm, 2007).

At international level, it is interesting to note that even international financial institutions namely the World Bank and the International Monetary Fund (IMF) are also interested in remittance to the sending countries. IMF for example undertook a study regarding the macro-economics of remittance for Tajikishtan (Kireyev, 2006), while the World Bank searched public opinion on how the remittance from USA and Japan is disposed in the Latin-America sending countries (Bendixen & Onge, 2006). A World Bank paper by Maimbo & Ratha (2005) studied the development impact of remittances as well as looking at its future prospects.

At the micro level, economists interest goes as far as findings that investing remittances in small and medium business enterprises have increased family income, as experienced by the Philippines (Semyonov & Gorodzeisky, 2005) and the Nepalese (Thieme & Wyss, 2005). Moreover, in Mexico it is discovered that the micro economy has grown along with the growing number of the micro-businesses (Christopher & Centeno, 2007).

No doubts that from remittances alone, the women migrant workers may save the country from economic crises, both at at the macro level, and at the micro level. In the earlier it is related to the foreign currency income of the country, while for the latter it helps to create employment opportunity for the family, the smallest social unit where better living expectation maybe bring into reality. Thus, given the importance of remittance for the sending country, the vulnerability issues of women migrant workers have to be regarded as strategic national issues worth of attention. Yet, the problem is, as one may guess, in a country with no gender sensitivity, almost nothing is discussed about the problem encountered by the women as the human resource who make the remittance available. The problems and issues of the women migrant workers, those who earn that making sending remittances possible, are invisible remains, regardless the existing vulnerability from the women's perspective as describe in next section.

2. A Gender Sensitive Problems and Issues Experienced by the Indonesia Migrant Workers in Hong Kong.

Among the Indonesian academes research work concerning women migrant workers in Hong Kong is scanty. Only several studies have been found. In early 1990s, Wijaya (1992) discovered that the majority of the Indonesian women international contract workers as housemaids were recruited from the rural agriculture areas. They came from poor, but not too poor families, with High Schools as the highest educational attainment, either junior or senior High Schools. They belong to low social class in the community. They are also characterized by women workers without professional skills, never going abroad and having limited foreign language

capacity. It is quite obvious that working abroad is a risky undertaking, at least at the beginning. Therefore vulnerable situation maybe expected from the beginning at pre-recruitment stage. All the way in the long placement process, that include pre-departure training, the departure waiting periode, health check-up, interview for placement in the country of destination, passport and visa application for example, problems may occurs including violence, and women trafficking. It continues in the receiving country. Since the arrival in the port of entree, the placement process with agents, in the working place with the employers, and returning home, too, they are subjected to various kind of vulnerability to lost of life. Thus social protection and, or, workers protection is greatly needed (Wijaya, 1992; Syafaat, 2005). Alas, the state protection to the migrant women at the work place is almost absent, although regulatory policies exist, but it involves impossibility in implementation as describe next.

In Indonesia, Law no.39/2004 regarding Placement and Protection for the Indonesian Migrant Workers is promulgated in year 2004. This was resulted from initiation and facilitation by NGO alliance, by whom a draft concerning Social Protection for the Indonesian contract workers has been pushed forward to the People's Representative Assembly about mid-1990's. Rahayu (2011) found that by 2010 no implementation has been undertaken. In the meantime, problems of sending workers keeps increasing. For example in the case of the so-called illegal migrant workers. Through a coordinated cunning method of sending workers, or namely, trafficking person, without travel document manage entering country of destination (Wijaya, 2004). This is in addition to the illegal status that happens in the receiving country due to passport confiscation by the agents soon after arrival.

Still focusing in the sending country, a study of Sukesi et al (2005), on the impact of migration on the family left behind found that the family structure has changed due to the absent of a mother who work overseas for years. The gender role of a women as wife for a family caring function and as a mother for children is taken over by the husband or other extended family member. The gender roles of the women is seems to be not substitutable. The men left behind show lack of capacity to conduct multi-tasking job related to household chorus. As a result, at least, the children schooling and the children attitude are affected. Surprisingly, evidence indicates that the husband's attitude has change, such as ignoring their children, finding another women, spending the remittances just to please himself, leaving the children behind on their own in search of job elsewhere as retaliation to the women in Hong Kong, where in most cases vulnerabilities exists This has created psychological burden to the migrant women at their workplace in far away land. No peace when their mind is occupied with her family situation. The internalization of gender ideology keep their mind set on the gender roles responsibility, regardless that their roles is changing to be main income earner.

As for the returnees, in search of income earning activities back home, they usually are trapped in the traditional self-employment work with almost no bussiness skills, and falls into informal economy, social protection is still in great need (Sukesi, 2006 and 2008). In East Java, women cooperatives has been established, with financial resource originating from the left over remittance. This is the only institution considered work well to offer economic protection. In the situation where remittance is transferred home to the family left behind, vulnerabilities exists. By bad experiences in the past , the

migrant women workers have tried their luck to transfer the remittance to the Cooperative institutions managing the remittances. In many cases failures have occurred due to the dominant gender ideology within the financial institution, disempowerment facing the forceful husband, and miss-management of the husbands has been on going (Rosalinda,2011; Sukesi, 2012).

During the turn of the last century, toward the 3rd millennium, in an international discussion about employment of women as overseas contract workers found that the issues is a complex global economy and environment. This finding in fact is along the line of the 1992 research result which is organized by the Asia and Pacific Development Centre involving 12 Asian receiving countries and the sending countries. It was unanimously found that the benefits enjoyed by various institutions and people, while the women overseas contract workers must bear the brunt of the costs (Wijaya, 1992). These costs are not only a gender dimension of labor rights, but also human rights violation when it deals with, for example, physical abuse and sexual abuse (Wijaya, 1993). Moreover, from bad becoming worse, is the phenomena of organized trafficking of women workers abroad is observed (Wijaya, 2004, Syafaat, 2003, Rahayu, 2011).

Recently, at the national level, sensitivity among scientist started flourishing. A scientific meeting organized by Habibie Center (2010) regarding the Indonesian women migrant workers. It resulted in the mapping of their conditions, their problems and the available opportunities. Unfortunately, the women migrant workers protection in the workplace was not discussed. It shows the human rights side of the issue is ignored. This is also shown in join research between the State Ministry of Women's Empowerment and the Indonesian Science Institute about public policies for women migrant workers (Nagib, 2001). Social protection in the workplace is missing. In 2013, an International Conference on Gender and Migration organized by Chinese University in Hong Kong indicates that our paper as preliminary result of this research is the only one dealing with problems of women migrant workers as domestic helpers, indicates fresh findings through this research work.

3. Research Methodology

Hong Kong is selected purposefully as receiving country. The number of domestic helpers from Indonesia is not large, but it is on top of the rank as the highest number among other sending countries. By end of year 2012, there were around 163,000 women workers from Indonesia as domestic helpers. This is over and above the Filipino's, who, for a long time, had been on the top of the list.

The research was undertaken in year 2012 – 2013, with the following aims:

1. to identify problems encountered by the women migrant workers in the receiving country, and
2. to find a model for protection to the women migrant workers protection in the receiving country.

The statement of the research problem are two folds. Firstly is the absent of reliable information of the migrant women's at the workplace. Secondly is the almost absent of social protection from the sending country government while they work abroad. The related research questions have been expanded during the data collection, from initially two research questions as follows:

1. What are the problems faced by the women migrant

workers at the receiving country ?.

2. What are the existing social protection accessible?

Along with the research processes and more understanding of the situation, the research questions becoming 5. The additional 3 (three) research questions are :

1. What are the women workers personal coping strategies to deal with problems encountered,
2. What are the personal preventif measures to avoid problems?, and.
Is their any best practice shown by the labor recruiting agencies?

The first two research questions are closely related to the absence of the Indonesian protection to the women workers at the work place, while the third one is related to the labor recruiting agencies assigned by the Indonesian Consulate to provide protection

The research methodology employed in this research is the Women's Studies Research Methodology with feminist perspective, including participatory action approach, policy oriented, bottom-up approach based on grounded issues experienced by the women migrant workers, the researchers and the researched are on equal status, personal experience is the main data source, collective and comprehensive information from all involves in provision of social protection

It is a qualitative research of the life experience and personal experience in the working place. The data is collected using various methods possible including in-depth interview, focus group discussion, a round-table discussion, and observation. The data is analyzed using descriptive analysis, contextual and textual analysis. In addition to the Hong Kong women migrant workers on the site, information is also collected from the returnees. The selected location is the Malang regency, East Java province, Indonesia, where the highest number of the migrant workers are originated from.

III. Results and Discussion

Gender ideology play roles in all aspects, from management system since recruitment, placement in Hong Kong up to the returning home. Many institutions involve, where all is governed by existing policies. Regulatory policies has been promulgated in the form of laws and its directives. The overseas migrant women workers are the subject of the policies and the regulations..

1. The Grounded Issues at the Work Place

Regardlss the good points about Hongkong as receiving country compare to Saudi Arabia, and Malaysia for example, the Indonesian women who internationally migrated as domestic helpers in Hong Kong as working place suffered from various problems as describe as follows.

a. Basic Problems

Current research has discovered various problems encountered by that surprisingly are almost the same with the findings of 2005 research by IMWU (Indonesian Migrant Workers Union). It implies that within 8 years time, nothing is undertaken to solve problem of:

- High salary cut, up to 7 months working days
- Underpayment
- Wicked Hong Kong placement agents
- Unilateral in-termination by the employer
- No possibility to change employer during the term of contract
- Language constraint and barrier.

- Hong Kong culture.

Classified as economic problems are unpaid salary, underpayment, high recruitment and placement costs that is equivalent to 7 months salary which is directly at the beginning of employment. Under-payment is common for a long time from the beginning of women migrant employment. A visit to a shelter during the data collection, namely the Bethune House that is managed by the Philippines, at that time 9 migrant workers from Indonesia and 3 persons from Philipinnes seek refuge after running away from their employers. The reasons for leaving the employers are various, such as sexual violence such as rape, physical violence for example beating with broom, verbal abuse, unilateral in-termination by the employer, contract violation for instance long working hours over and above length of working time daily in the contract, over stay while lawsuit case still ongoing, and salary borrowed by the employers and no repayment until the end of the working contract. The later is unusual one because the agent is agree with it and eventually taking the side of the employer, no repayment is enforced from the employer.

It seems that serious problems encountered by the women migrant contract workers is originated from unfamiliar culture and Cantonese as foreign language. Lack of language proficiency results in communication breakdown or miss-communication, including resentment to the women workers by employers. This leads to physical and abusive violence against women workers, and unilateral contract termination by the employers. As personal protection measures to end the unbearable burden, they run away and subsequently changing employer.

Other problems faced by migrant workers are sexual relationship both with opposite sex. The opposite sex usually are the refugees male African and South-Asian migrants, ranging from personal interest to rape. The problem is related unwanted pregnancy and unwanted children. With neither understanding nor knowledge about Hong Kong laws applied to workers during pregnancy, the women migrant creating their own problem through resignation and breaking the working contract, lading to deportation as applied to the migrant workers who are more than 2 weeks with no employment.

b. Coping Strategies of the Individual Women Migrant Workers .

More than usual, conventional science and the related academes do not belief that individual women have policies. This notion is very much related to the internalization of the gender ideology. For the migran women workers, class differences applies where they are at the lower rank than the employer. They are labeled with women stereotypes blended in culture. Typically they are treated as subordinates, considered as lower class, stupid, incapable to make decisions, to mention only several. From their sides, tough life as the women domestic helpers from in the work place has make them thinking about survival strategies as well as coping strategies. By itself these can be regarded as their individual policies, that they put into practice. Whether they like it or not, their individual policies are their own way to survival until the end of their working contract. Mind that there are igrant workers who are lonesome when family as supported group they used to have are not around, and the government is absent to support them, survival and coping mechanism individual policy is important for them. The fact is in the premisses of the

employer, the women workers work in isolation, along with the worry regarding the termination of work that can happen any time before the end of the contract

Best practice by the women migrant workers such as survival strategies as individual policy to survive In Hong Kong are:

- Enhancing the communication ability in Cantonese
- Adapting the daily life of the Hong Kong residence, particularly the employer
- Organizing among migrant workers peers
- Knowing how to contact and the address of shelters just in case in need
- Having capacity and courage to report in the police station
- Empowered to be self-reliance

The above list looks simple and noting special for those who know the way of the world. But for the women migrant workers, who start from the beginning, indeed, it involves personal struggle. The finding of Rahayu, (2011) and Burhanudin (2007) that the Indonesian representative are not yet implementing protection policies in the workplace regardless the existing law confirmed the importance of personal policies.

c. Best Practices of all involving parties

Even though this research about the Indonesian migrant workers in Hong Kong, the root causes of problems initiated from the sending country, Indonesia. Good roots is believed to produce good fruits and vice versa. Through observation, the best practices in Indonesia during the recruitment and preparation before placement in Hong Kong is presented, followed by best practices by agent in Hong Kong.

c.1. Best Practices in Indonesia

As many as 5 points has been discovered during the research work that are considered best practices. These are:

1. *PJTKI/PPTKIS* (Private recruiter and placement agencies)
 - Caring to women migrant workers
 - Have already developed good link with agents in Hong Kong
2. The women migrant workers to be :
 - Having mature personality
 - Having personal motivation to work as migrant abroad
 - Ready to undertake the job
3. The family left behind: well prepared to run daily life without the internationally migrated women workers.

Those points are potentially useful to be included in the model development and, too, the items next step to be developed as protection policies. Note that policy stated by the three stake holders are naturally different depending on the role of each. Interestingly it complement each other.

c.2. Best Practices in Hong Kong

Best practices from stake-holders are as follows:

1. The *KJRI (Konsulat Jenderal Republik Indonesia - the Republic of Indonesia General Consulate)* in Hong Kong. The notable best practice is a net-working with Path-Finder, an NGO cares for unwanted pregnancy among the women migrant workers in Hong Kong, mothers of the unwanted Hong Kong born children, the newborn baby/children protection, including obtainment of fatherless Childbirth Certificate. In the meantime, controlling the Hong Kong local placement agencies who are assigned by the Indonesian representatives to be

responsible for the women migrants' placement and provision of social protection is subject to controversy by many.

2. Hong Kong Placement Agencies :

Indeed, it is a rare one. Eventually, Hongkong migrant workers Placement Agencies practicing good undertaking, has been identified, judged by the following criterias:

- caring the under-standard conditions of the newly arrived worker
- responsive to the needs of the women migrant workers new arrival.
- Aimed at success orientation on both sides, the employer and the women migrant worker.

For the agent itself, caring and the success orientation are said so as their main policy to meet the needs of both, the women migrant worker and the Hong Kong employer. What is unique about the agent is that it is managed by a joint venture of an ex-Hong Kong women migrant workers and her ex-employer. Learning from the past personal experience making them producing the best practice representing the needs of workers and employers. The procedure is unique too. For example but the entire family members and any one resides in the house of the employer are requested to go the agency's office for interview. An extra practical training of household chorus, language proficiency and culture is provided to meet the individual needs. During the first month working, the agent monitor and take complains for a better employer-employee relationship. The weekend holiday is organized among all workers recruited by this agencies in the office, where various activities maybe undertaken such as sharing, counseling, Cantonese language, cooking class, having rests, to mention several. For the agent this organized weekend worth as:

- Evaluation and monitoring by the agent
- Maintaining close relationship with the recruited workers
- Find solutions for any problems faced by the workers
- Early problems identification
- Avoiding dangerous encounter with refugees from various African countries and South Asian Countries who creating problems of unwanted pregnancies
- A family like situation to counter loneliness, and, or, homesickness.

Through communal weekend, the women migrant workers believed that they are well taken care by the agent. From the employers side, problem solving is easy because the agent is responsible to migrant worker they recruited.

3.The Indonesian migrant women workers:

A couple of best practices have discovered are:

- Having competency and being professional working in foreign country even as domestic worker
- Future oriented: make the best use of opportunities and resources during placement in Hong Kong useful for returning home post working contract

For the women migrant workers, competency means a lot. In detail, beyond what they receive in the pre-departure training camp, for example it starts from the time they enter into international airport in Indonesia during departure, in the aeroplane to order food and fill-in the form and how to get out from the airport in Hong Kong on arrival and beyond. They should

know exactly what to do. Thus, they should act as professional traveler:

- Capable to make departure confidently on their own.
- to proceed in compliance with all procedures necessary during arrival in the terminal building, through immigration, baggage claim and getting out of the airport
- outside the airport: in case there is no one from the agent pick them up from the airport they know how to take a public transport going to the agent's office.
- they know their rights and responsibilities as written in the contract
- They know what to do as problem solving just in case there is a problem encountered even they just arrive in the working place.

The Hong Kong agencies are notoriously wicked, exploitative, unfriendly, hard pressing to obtain maximum profit. In the situation where language is not yet fluent, this hard to deal with. In the mean time, doubtful that these agents are under the full and strong control of the Indonesian representative (*KJRI*) in Hong Kong. The Republic of Indonesia General Consulate should handle the new arrival seriously as part of citizen service.. The vision of *KJRI* as read on its wall is:

"KJRI sebagai rumah yang ramah bagi semua warga Indonesia di Hong Kong (The Republic of Indonesia General Consulate is a friendly home of all Indonesian in Hong Kong)" have to be well disseminated to all migrant workers particularly the new comers, rather than merely slogan on the wall.

Sadly, briefing on Living in Hong Kong culture to the new arrivals of migrant workers. the following briefing materials is missing:

- The Cantonese as unique language
- Introducing institutions and NGOs that provide social protection service
- Introducing expectation that post-contract, the human resource capacities of the women workers should be developed through various training and education
- Women migrant workers empowerment against powerlessness and poverty background in the country of origin.

These items may be delivered, only and only if the Women's Studies methodology is applied.

4. The Current Service-providers

Facilitated by the Hong Kong University, a focus group discussion with NGOs in Hong Kong with activities offering social protection services to migrant workers (e.g. Christian Action, Path Finders, Bethune House, and Indonesian workers organization namely the *Komunitas Migran Indonesia* (KMI), IMWU, and ATKI, it is found that exactly the NGOs are the social protection providers As Government, passing on the responsibility to the recruiting and placement agencies operating outside the domain of Indonesian State, it is impossible. These agencies interested in the profit making rather than humanity interes.

When Hong Kong, tiny islands, yet hosting numerous NGOs and organizations of migrant workers, indicates that the problems encountered by the women workers are deep, comprehensive and serious. The existing organizations maybe classified into the following categories:

- Indonesian national NGOs (Dompot Duafa, Komunitas Migran Indonesia or KOMI),
- Hong Kong local/national NGO (e.g. Christian Action)

- International NGOs (e.g. including Bethune House's, Catholic Shelter, Path Finders, Asia Pasific Mission on Migrants, Helpers for Domestic Helpers, Enrich, Mission for Migrant Workers),
- Coalitions organizations e.g IMWU, ATKI, KOTKIHO
- Network of the Indonesian provincial or ethnics groups, such as Yogya Club of Women Migrant Workers.

When the Representative of the Indonesian Government is absent from action, the non government organizations take responsibility to provide social protection, be it the Hong Kong local NGOs, international NGOS, and even Indonesian NGOs. The NGOs seem altruistic in offering their service to protect the unprotected Indonesian women migrant workers. Their activities ranging from legal service, language proviciency, women empowerment, and to offer needed help including just a shoulder to cry on, and various educational activities such as skill training. It is only obvious that the Indonesian migrant workers who suffered from problems need protection and supportive grounded action. If for some reasons the Government Representatives could not perform this tasks, collaboration with NGOs may be a good solution. The GO-NGOs collaborations might be odd at the beginning. A good example that has been working is good relationship with Path Finder. This system may be extended to NGOs.

Workers issues that need to be addressed in Hong Kong are numerous. It is truly impossible to hand their problems to Hong Kong Agent. Comparative analysis concerning action and activities between the Hong Kong agents which is economy and profit orientation, is indeed contrast to what the NGOs activities and performance are, which is social activities, non-profit and humanitarian. This way, the Indonesian policies as read in Law No.39. year 2004 the appointment of the Placement Agencies of women migrant workers in the receiving country as responsible institutions providing social protection to the women migrant workers during placement time is weird. Women migrant workers perceived that agents are notorious in making a hard life. Discussion about this policy is perceived by them as a big joke of impossibility.

Academes and the university where they are attached to maybe considered as service provider, such as conducting research, translating research results into policies, facilitation between various parties involved. Discussion among academes of Brawijaya University and the Hong Kong University academes has concluded that to deal with problems faced by the women migrant workers and its relevant social protection, the academic research ought to be based on Women's Studies as best suited one to obtain data, to undertake suitable analysis such as feminist analysis, gender analysis, needs assessment and analysis, and the best problem solving result to free the women migrant workers from the absent of social protection. It has been agreed that within the realm of its praxis, the academic research should cover both the practical issues and the strategic issues. Future join research between these 2 universities is regarded most efficient, judged from location mastery based on country where the scientists are originated from, the language and the culture. In addition, this is also timely with the promulgation of ILO Convention No. 189/2011, regarding protection to the women migrant workers as domestic helpers. To the dismay of Women migrant workers and NGOs, by 2013 this convention has not been ratified by the Hong Kong Government. The women migrants workers and their organizations are looking forward to its ratification and implementation.

5. The Indonesian Government Representative’s Involvement in Social Protection

The representative claimed play control to the Hong Kong agents, that by the Indonesian Law No.39/2004 in the place of work, the protection is performed by the Hong Kong placement agency. This law, is the only Indonesian law available dealing with protection. However, a content analysis discovered that out of 109 chapters of the Law, the large portion is regarding placement, while 8 chapters only dealing with protection in the work place. It is in this law that verses about protection responsibility is placed on the hand of Hong Kong Placement Agents is regulated.

Last year a *KEPPRES (Keputusan Presiden, Presidential Decree)* has been passed dealing with recruitment costs at a lower rates. However, by end of 2012 it remained unimplemented. The women continued be treated unfairly, eg exploited by 7 months unpaid work in the beginning of employment, said so to cover the recruitment costs, pre-departure training costs and the international ticket. When later they know that the employers share the international airfare to Hongkong, it creates heart aching, and wonder, who could it be receiving the double air fare amount of payment? In the meantime, at International level the ILO Convention No.189/2011 that has been passed as a global standard regulation toward a decent life and protection of domestic helper abroad does not cover all of the points of problems As above mentioned, even by early 2013, the Hong Kong Government has not ratify it yet

It can be concluded that women migrant workers need effective protection that works and accessible to them. Solution must be sought to fill in the gap between the absent of adequate laws and policies development to provide protection at the work place. Pre-requisite to the redrafting of existing law, and, or, policies, a model is required. A bottom-up system is is engineered to design model toward social protection for migrant women workers.

C. PROTECTION POLICY MODEL FOR THE INDONESIAN WOMEN MIGRANT WORKERS IN HONG KONG

A social-engineering technology has to be undertaken to design social-protection model for the Indonesian migrant women workers where Hong Kong is the placement country because the Indonesian policies for social protection provisions in Hong Kong as the receiving country is almost impossible. As the reality of protection for so long has been carried out by NGOs, the model should take into account all the NGOs and stakeholders currently involve in services provision to solve the problems encountered. The policy is problem solving oriented.

Due to the limited research resources, this research only achieved a goal of a social engineering a model to stir the government knowledgeable and taking action in the social protection provision to its citizens working in Hong Kong. The model is based on the new interdisciplinary science namely Women’s Studies. The following standard is applied:

Orientation: Problems solving orientation to release the women from unfortunate situation related to human rights and workers’ rights.

Problems undertaken for consideration: it must be carefully selected from the de facto issues, grounded problems of the real personal experience of the women migrant workers particularly that is continuously happen, abusive since the time

migrant workers employment in practice

Approach: participatory by all parties involved:

- i. The women Migrant Workers as the target group: their voice and needs must be heard particularly related to gender equality and gender equity and beyond;
- ii. The NGOs that, for so long, altruistically have been taking action to protect women migrant workers in the situation they need help when the government is not available.
- iii. The researchers, Indonesian and the Hong Kong based academes having knowledge, and mastery in Women’s Studies, to conduct mediation and to provide facilitation.

Features: it must be comprehensive and inclusive with respect to aspects encountered.

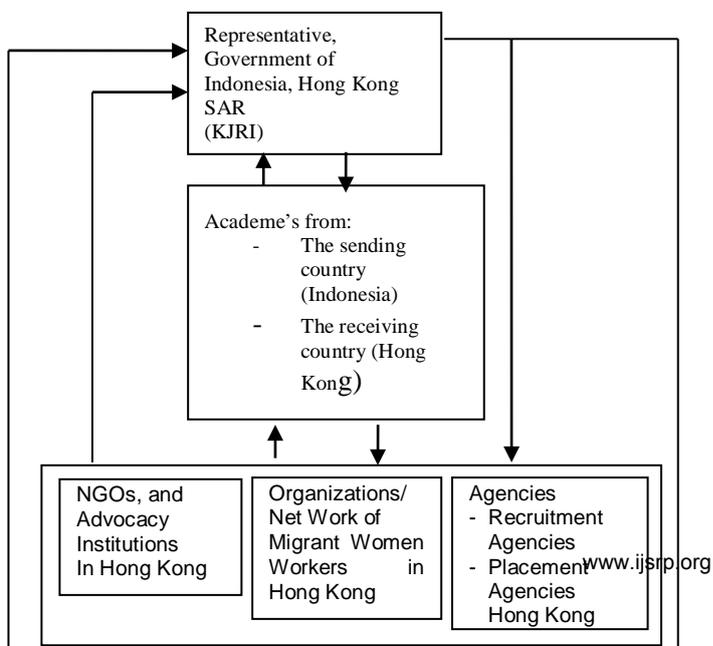
- i. Related to comprehensive matters is new approach should be taken into account beyond the standard practice, for example with the newly introduced components. It may go beyond the existing ILO standard for security system of formal-workers employment.
- ii. The undertaking should go as far as the root causes of the problems are.
- iii. The translation of the policies should be as exhaustive as possible

It means that aspects of preparatory stage including pre-departure procedures and processes should receive adequate attention. This is a great challenge because it involves the private labor recruiting agencies, repressive to the migrant workers, and that they operate independently along the private to private mode of ending and receiving migrant workers. The bottom-up approach is new to the he Indonesian Government, too, representatives in Hong Kong. since top down, which is the reverse of bottom-up approach, is the popular policies. It has been decided that the academes, in particular those who have involved in research from the sending country and that from receiving country should be the framework, due to strategic roles they can performed:

- 1. The knowledge they obtained through the research work;
- 2. The roles as facilitators between the parties involved;
- 3. The capacity to understand each country situation, eg. In Hong kong by the Hong Kong academes, and in Indonesia by the Indonesian academes.

Policy development by the executives and legislators usually do not involve academes. Couple with Women Studies as new science, his new approach is challenging to deal with.

Simply, the model which is essentially a system to develop policies for migrant women workers in the work place in Hongkong which is necessarily should take into account problems and issues at all levels. (Framework 1)



- Personal saving program is necessary for future capital protection, including self control in general and shopping during the weekend holiday to avoid unnecessary spending, careful in a bank choice for the personal banking, and trustworthy bank for transferring remittance to the family left behind.
- e. Protection in the travelling process for home returning.

For returnees, to arrive home in Indonesia can be a real burden, as it may cost their lives. Once the air carrier landed, anything bad can happen from going through since international airport immigration, customs. Labor department officials, transit and dealing with transportation program bringing them back to the place of origin. In the international Airport where special Terminal for the returnees established, encounter with the officials of the Labor Ministry, plus people targetting them as a pray for bluffing, bullying, robbery, exorbitant price offer for transportation services, terribly low illegal exchange rate, rape, killing, time consuming services and various ways people could have done to them as target of prey for exploitation are what they have in mind. For some women, passing through the international airport procedure is stressfully worrying. Better policies for returnees must be discussed through the model above mentioned. The fact that the women seems lost in confidence to the parent Government representatives, and, instead, that their trust goes to NGOs perceived as good institutions showing honesty in offering service, and genuinely providing solution to their problem must be taken into account. Due to the limited research resource, this research only arrive at a model, as intermediate result toward an end. A serious action research to implement the model into practice have to be done in the near future, where adequate funding is required.

V. Conclusion and Policy implications

There are various grounded problems encountered by the women migrant contract workers in Hong Kong that protection is obviously in great needs. Currently, protection in the workplace ruled solely by Law No.39/2004 regarding Protection and Placement overseas that is inadequate to provide protection in Hong Kong. The only explicitly mentioned is that in the receiving country, the protection is the responsibility of the placement agents in Hong Kong, as consequence of private to private migrant workers sending and receiving mode. For more than 40, years, which is equivalent to a one generation time, policies according to the migrant workers lack of gender responsive protection for women migrant workers. This research provides a solution. It may be done in several steps, depending on research resource available. The model is necessarily bottom-up, synergic, participatory, and comprehensive in nature. It should urgently followed with further attempt to put into practice through drafting the required policies, done items by items, based on the grounded problems personally experienced by the women's migrant workers at the work place. This will be a new approach which is against policies conventionally designed behind desks.

To do so however there is a pre-requisite. A join action research is required to explore further the situation, necessary, unexplored, unknown and untouched yet, to make the academe to be better equipped, and to be better organized in facilitation undertaking in the drafting process of the policies. This research should be conducted jointly between researchers from the sending country. This also implies that financial support is

The framework of policy development model by the Indonesian Government Representatives for migrant workers social protection provision in Hong Kong

This framework is the crystallization of the research findings. As well, it is creative ideas with feminist perspective involving the government as policy makers. All parties involved must be included in the model to take part in bottom-up approach. Relevant policies ought to be developed responsive to the grounded issues faced by the women migrant workers at the bottom level who are victimized, for example:

- a. Empowerment of the women migrant workers to be personally mature and mentally ready to bear the brunt all of the possible consequences;
- b. Preparing the family left behind without the women as dictate by gender ideology,
- c. Protection at the workplace, that includes:
 - The women migrant workers have a copy of the written working contract in the Indonesian language, rather than currently in English language and Cantonese they do not understand.
 - Specific problems and issues dealing with various institutions including.:
 - The Hong Kong placement agents that usually on the side of employers,
 - Health insurance obtainment, access to health service including hospital service, related to the personal needs of the women migrant women herself. Capacity to deal with health services independently to meet the health care needs of the employer and their family members where she is employed, or the health care needs of her peers.
 - Knowledge, courage, access to shelter, to police officials, tribunal, court, lawyer, interpreter when it is needed such as in court case, and protection against HIV/ AIDS infection and unwanted pregnancy.
- d. Future financial protection
 - Managerial skill of financial investment for returnees toward sustainable income earning.

Hong Kong immigration regulates that every migrant workers have to go home after their contract ended, regardless the number of contracts they have made and the length of time they have stayed in Hong Kong. Thus no permanent residency is granted for the migrant women in Hong Kong. Therefore the weekend holidays ought to be used for quality time for improving skill trainings such as course work (various skills, language, Open University degree training program, writing skills for professional writer, computer to mention several) and writting articles, novel, and commercial books.

required both for the joint research and, subsequently, to conduct action research for policies drafting that could be a longitudinal one in terms of time. Committed funding agencies are invited to allocate their fundings to make this benevolent attempt providing protection to migran workers possible.

Acknowledgement

Appreciation of the authors goes to the Directorate General of Higher Education, State Ministry of Education and Culture for the financial support to undertake this research. Our thanks also due to the Brawijaya University, Malang, Indonesia for the DIPA Brawijaya University no. 0636/023-04.2.16/15/2012, dated 9 December 2011. Last, but not least, we are grateful to the Institute for Research and Community Service, Brawijaya University for granting the Institutional Competitive Research Program Batch II (Decision letter of the Brawijaya University Rector No. 419/SK/2012 dated 27 September 2012) to conduct this research.

References

- [1] Adams, Richard H. and John Page. 2005. "Do international migration and remittances reduce poverty in developing countries?" World Development, Vol. 33 (10): 1645–1669
- [2] Anggraeni, Dewi, 2006, *Dreamseekers: Indonesian Women as Domestic Workers in Asia*, Equinox Publishing, Jakarta
- [3] Arm, 2007. "TKI Purna Produktif". Jurnal Suara Metro, 22 (1): 5-12.
- [4] Anonymous, Online dictionary websites:
<http://www.kamusbahasaindonesia.org/bahasa>
- [5] <http://www.i.word.com/idiictionary/language>
<http://bahasa.kemdiknas.go.id/kbbi/index.php>
<http://www.i.word.com/idiictionary/culture>
- [6] <http://www.colorado.edu/conflict/peace/treatment/culcomm.htm>
- [7] Baharudin, Erwan. 2007. "Perlindungan Hukum terhadap TKI di Luar Negeri Pra Pemberangkatan, Penempatan dan Purna Penempatan", Lex Jurnalica.4(3): 162-175
- [8] Bendixen, Sergio and Eric Onge. 2005. "Remittances from the United States and Japan to Latin America: An in-depth look using public opinion research." In Donald F. Terry and Steven R. Wilson (eds.), *Beyond Small Change: Making Migrant Remittances Work for Development*. Inter-American Development Bank, Washington, DC.
- [9] Bohning, W.R. 1984, *Studies in International Labor Migration*, Macmillan Press, London
- [10] Buchori, Chitrawati, Farida Sondakh, and Tita Naovalitha, 2003, *TKW's Vulnerability: Searching for Solutions*, World Bank, Jakarta
- [11] Chia Lan, Pei, 2006, *Global Cinderellas: Migrant Domestic and Newly Rich Employers in Taiwan*, Keystone Typesetbif, Inc, Taiwan
- [12] Christopher & Centeno, 2007
- [13] Cohen, Robin, 2008, *Migration and its Enemies: Global Capital, Migrant Labor, and Nation State*, Ashgate, Hampshire
- [14] Constable, Nicole, 2007, *Maid to Order in Hong Kong: Stories of Migrant Workers*, Cornell University Press, Ithaca
- [15] De Haas, Hein, 2007. "Morocco's migration experience: A transitional perspective." *International Migration*, Vol. 45, No. 4, pp 39–70.
- [16] Dinas Tenaga Kerja dan Transmigrasi Kabupaten Malang, 2010, *Pemberdayaan Buruh Migran Melalui Remitansi dan Perluasan Kerja untuk Memperkuat Pembangunan Ekonomi Daerah*, DISNAKER Kabupaten Malang, Malang
- [17] -----, 2010, *Profil Tenaga Kerja Indonesia Kabupaten Malang Tahun 2010* DISNAKER Kabupaten Malang, Malang
- [18] Dupraw, Marcelle E and Marya Axner, *Working on Common Cross Cultural Communication Challenges*, 2012.
<http://www.pbs.org/ampu/crosscult.htm>
- [19] Erwan Baharudin, 2007. *Perlindungan Hukum terhadap TKI di Luar Negeri Pra- Pemberangkatan, Penempatan, dan Purna Penempatan*. Lex Jurnalica Vol. 4, no ,,,,
- [20] Fan, C. Simon and Oded Stark. 2007. "International migration and 'educated unemployment'." *Journal of Development Economics*, Vol. 83, No. 1, pp. 76–87.
- [21] Faist, T and M Fauser, 2011, 'The Migration–Development Nexus: Toward a Transnational Perspective', Palgrave MacMillan
- [22] Fajnzylber, Pablo & J. Humberto Lopez, 2008, *Remittances and Development: Lessons From Latin America*, The World Bank, Washington DC
- [23] Gammage, S. 2006. "Exporting people and recruiting remittances: A development strategy for El Salvador?" *Latin American Perspectives*, Vol. 33, No. 6, pp. 75–100.
- [24] -----, 2010, "Migration and Development: A Theoretical Perspective", *International Migration Review*,
- [25] Ghosh, Bimal (2006), *Migrants' Remittances and Development: Myths, Rethoric and Realities*, International Organization for Migration, Geneva and teh Hague, Geneva, and the Hague Process on Refugees and Migration, The Hague
- [26] Iredale, Robyn, Fei Guo, & Santi Rozario, 2003, *Return Migration in the Asia Pacific*, Edward Elgar Publishing Limited, Cheltenham
- [27] Irianto, Sulistyowati, 2011, *Akses Keadilan dan Migrasi Global: Kisah Perempuan Indonesia Pekerja Domestik di Uni Emirat Arab*, Yayasan Pustaka Obor Indonesia, Jakarta
- [28] Kireyev, A. 2006. *The Macroeconomics of Remittances: The Case of Tajikistan*. International Monetary Fund, Washington, DC.
- [29] Koc, I. and I. Onan. 2004. "International migrants' remittances and welfare status of the left-behind families in Turkey." *International Migration Review*, Vol. 38, No. 1, pp. 78–112.
- [30] Kaur, Amarjit & Ian Metcalfe, 2006, *Mobility, Labor Migration and Border Controls in Asia*, Palgrave Macmillan, New York
- [31] Legrain, Phillipe, 2007, *Immigrants: Your Country Needs Them*, Abacus, London
- [32] Maimbo, Samuel Munzele & Dilip Ratha, 2005, *Remittances: Development Impact and Future Prospects*, The World Bank, Washington DC
- [33] Mishra, Prachi. 2007. "Emigration and wages in source countries: Evidence from Mexico." *Journal of Development Economics*, Vol. 82, No. 1, pp. 180–199.
- [34] Morrison, Andrew R, Mauric Schiff, & Mirja Sjoblom, 2008, *The International Migration of Women*, Palgrave Macmillan, New York
- [35] Nagib, Laila 2001, *Studi Kebijakan Pengembangan Pengiriman Tenaga Kerja Wanita ke Luar Negeri*, Jakarta: Kantor Menteri Negara Pemberdayaan Perempuan dan PUSLITBANG Kependudukan dan Ktenagakerjaan, Lembaga Ilmu Pengetahuan Indonesia (PPT-LIPI)
- [36] Poirine, Bernard. 2006. "Remittances sent by a growing altruistic diaspora: How do they grow over time?," *Asia Pacific Viewpoint*, Vol. 47, No. 1, pp. 93–108.
- [37] Parnas, Rachel Salazar, 2001, *Servant of Globalization*, Stanford University Press, California
- [38] Rahayu, Devi. 2011. "Perlindungan Hukum bagi Buruh Migran terhadap tindakan Perdagangan Perempuan", *Perlindungan Hukum*, Vol.18, NO.1, pp 115-135
- [39] Rosalinda, Henny, 2012. *Social Remittance as impact of International Migration : The Returned Migrant Women in East Java*, Indonesia, GSID Nagoya University.
- [40] Sukei, Keppi, 2012. *Empowerment of Indonesian Women Migrant Worker Through Utilization of Information and Communication Technology in East Java*. *Intrenational Journal of Social Tomorrow (IJSST)*, Vol 1 no. 10
- [41] -----, 2005. *Dampak Migrasi Internasional Terhadap Keluarga*, Unpublished Research Report.
- [42] -----, 2007. *Penelitian Aksi untuk TKW melalui Kegiatan Koperasi dan Pencegahan Kekerasan dalam Rumah tangga (KDRT)*. Unpublished Research Report.
- [43] -----, 2008. *Kajian dan Pelatihan Kewirausahaan bagi TKW Purna*. Unpublished Research Report.
- [44] -----, Alfrina Hany, Kuswanto, Asmika, 2009.. *Survey dan Deteksi Dini HIV AIDS di Kalangan TKW di Bandara Juanda*. Unpublished Research Report.
- [45] -----, Alfrina Hany, Kuswanto, 2012. *Survey of HIV AIDS and Sexually Transmitted Disease in Indonesia Migrant Workers Arrived at Juanda International Airport Surabaya*. *Journal of Basic and Applied Scientific Research*. Vol 2 (6): ...
- [46] Syafa'at, Rahmat, 2003. *Dagang Manusia: Kajian Trafficking terhadap Perempuan dan Anak di Jawa Timur*, Lappera Pustaka Utama., Yogyakarta
- [47] -----, dkk. 2002. *Menggagas Kebijakan Pro TKI : Model Kebijakan Perlindungan TKI ke Luar Negeri*. Di Kabupaten Blitar. Kerjasama BAPPEDA Kabupaten Blitar dengan Pusat Penelitian Hukum dan Gender, FH UB, Unpublished Research Report..
- [48] Semyonov, M. and A. Gorodzeisky. 2005. "Labor migration, remittances and household income: A comparison between Filipino and Filipina overseas workers." *International Migration Review*, Vol. 39, No. 1, pp. 45–68.
- [49] Thieme, Susan and Simone Wyss. 2005. "Migration patterns and remittance transfer in Nepal: A case study of Sainik Basti in western

- Nepal." International Migration, Vol. 43, No. 5, pp. 59–98.
- [50] The World Bank, Migration and Remittances Factbook, 2011, Second Edition
- [51] Woodruff, Christopher and Rene Zenteno. 2007. "Migration networks and microenterprises in Mexico." Journal of Development Economics, Vol. 82, No. 2, pp. 509–528.
- [52] Wijaya, Hesti. R., Pandriono, Sugiyanto dan Heru Santoso. 1999. Liku-liku Perjalanan TKI-TKI Tak Berdokumen ke Malaysia. Gama Press. Yogyakarta.
- [53] _____, 1992. International Migration of Indonesia Women to Saudi Arabia: With a Micro Study from the East Javanese Domestic Helpers. Unpublished Research Report, The Rural Development Foundation in collaboration with the Asian and Pacific Development Center, Kuala Lumpur. Malaysia (Unpublished Research report).
- [54] _____, 1992, Employment of Migrant Women Contract Workers to Saudi Arabia : the Benefits, Costs, Colombo, November 1992, presented paper in the International Migration of

- Asian Women, Colombo, Organized by Asia and Pacific Development Centre,
- [55] _____, 1992, The Indonesian Migrant Women Contract Workers to Saudi Arabia: Problems and Impacts, presented paper in the Women's Tent, NGO Forum, World Environment Conference, Rio de Janeiro.

AUTHORS

- First Author** - Hesti R. Wijaya, Ph.D holder from the University of Melbourne , Australia, Brawijaya University Post Graduate Program, Master Degree Course on Women's Studies, email address m.hestiw@yahoo.com
- Second Author** – Keppi Sukei, Professor in Sociology, Brawijaya University Post Graduate Program, Master Degree Course on Women's Studies email address keppi_s@yahoo.com
- Third Author** – Henny Rosalinda, MA holder from Nagoya University, Japan, Brawijaya University Post Graduate Program, Master Degree Course on Women's Studies email address rosalinda08@yahoo.com

Effect of Drip Fertigation Pigeonpea Resultant Seed on Seed Storage

S. Manikandan* and K. Sivasubramaniam**

*Department of Seed Science and Technology, Agricultural College and Research Institute (TNAU), Madurai – 625 104, Tamil Nadu, India.

**College of Agricultural Technology, Theni – 625 562, Tamil Nadu, India.

Abstract- The present Investigation was carried out to elucidate the storability of drip fertigation resultant seeds of pigeonpea (cv.VBN 3).The laboratory studies were conducted at Agricultural College and Research Institute, Madurai, during 2011. The study on resultant seed storability revealed that, among the 13 treatments, T₄, T₅, T₆, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂ were good storers, while T₁, T₂, T₃ and T₁₃ were medium storers. Whereas seeds stored in polyethylene bag maintained a germination of 93.0 per cent after nine months of storage and the seed quality characters in terms of physiological and biochemical parameters decreased with ageing irrespective of treatment and containers.

Index Terms- Pigeonpea, Resultant seed, Storage, Containers, Physiological, Biochemical, Quality

I. INTRODUCTION

Pigeonpea is the most widely grown crop in the country and has been under cultivation for over three thousand years. With 22 per cent protein, which is almost three times that of cereals, pigeonpea supplies a major share of protein requirement of the predominantly vegetarian population in the country. The biological value improves greatly, when wheat or rice is combined with pigeonpea because of the complementary relationship of the essential amino acids. It is particularly rich in lysine, riboflavin, thiamine, niacin and iron. Pigeonpea is one of the most sensitive seeds susceptible to significant deterioration after year's storage. Pigeonpea like other proteinous seeds is more prone to deterioration due to its higher protein content (Powell et al. 2000). Seeds are required to be kept in safe storage since they are harvested in the preceding season and usually used for sowing in the subsequent season often after a time gap of six months or longer. During the aging process, seeds lose their vigor, ability to germinate and ultimately become less viable (Maity et al. 2000). Losses in seed quality occur during field

weathering, harvesting and storage. The losses are exacerbated if seeds are stored at high temperatures and or conditions of high relative humidity. Losses in seed quality occur during field weathering, harvesting and storage. Several intrinsic and extrinsic factors influence the viability of seeds during storage. Among intrinsic and extrinsic factors, seed moisture content, relative humidity, temperature of storage, pests and diseases and oxygen availability are more important. Deterioration of seed is a natural process which is inevitable, inexorable and irreversible but the rate of deterioration of seed may differ due to genetic factor (Wittington, 1978), storage environment and period of storage (Reddy, 1985) and seed treatment (Zhang *et al.*, 1989). Polyethylene and aluminum foil materials were moderately effective in preventing moisture uptake and maintaining seed viability, while paper and cloth containers were least effective (Wilson and McDonald, 1992). Seed deterioration is an inexorable and an irreversible process. One of symptom of seed deterioration is membrane deterioration (Copeland and McDonald, 1995). Hence, present studies were undertaken to assess the performance of drip fertigation pigeonpea resultant seed quality on seed storage under ambient conditions.

II. MATERIALS AND METHODS

The experiment was conducted at Agricultural College and Research Institute, Madurai during 2011. After harvest the pigeonpea resultant seeds were subjected to storage under ambient conditions and present findings clearly brought out the better performance of resultant seeds from drip fertigation treatments. In a laboratory experiment the bulk seeds of resultant seeds were separated based on the drip fertigation treatments wise and seeds were treated with bavistin @ 2 g kg⁻¹ along with control and were packed in different storage containers as below after the initial quality evaluations. The drip fertigation treatments details are given below.

Treatment details of resultant seeds

T ₁ (F ₁ FS ₁)	:	50 %	of SRDF through drip + Foliar spray	of 0.5 per cent Zinc sulphate
T ₂ (F ₁ FS ₂)	:	50 %	of SRDF through drip + Foliar spray	of 100 ppm Succinic acid
T ₃ (F ₁ FS ₃)	:	50 %	of SRDF through drip + Foliar spray	of 100 ppm Humic acid
T ₄ (F ₂ FS ₁)	:	75 %	of SRDF through drip + Foliar spray	of 0.5 per cent Zinc sulphate
T ₅ (F ₂ FS ₂)	:	75 %	of SRDF through drip + Foliar spray	of 100 ppm Succinic acid
T ₆ (F ₂ FS ₃)	:	75 %	of SRDF through drip + Foliar spray	of 100 ppm Humic acid
T ₇ (F ₃ FS ₁)	:	100 %	of SRDF through drip + Foliar spray	of 0.5 per cent Zinc sulphate
T ₈ (F ₃ FS ₂)	:	100 %	of SRDF through drip + Foliar spray	of 100 ppm Succinic acid
T ₉ (F ₃ FS ₃)	:	100 %	of SRDF through drip + Foliar spray	of 100 ppm Humic acid

T ₁₀ (F ₄ FS ₁)	:	150 % of SRDF through drip + Foliar spray of 0.5 per cent Zinc sulphate
T ₁₁ (F ₄ FS ₂)	:	150 % of SRDF through drip + Foliar spray of 100 ppm Succinic acid
T ₁₂ (F ₄ FS ₃)	:	150 % of SRDF through drip + Foliar spray of 100 ppm Humic acid
Control	:	Surface irrigation with SRDF of 25:50:25 NPK kg ha ⁻¹ by two splits.

SRDF : Seed crop Recommended Dose of Fertilizer

Storage Containers

C1- Cloth bag

C2- High Density Polyethylene (HDPE) bag

Then the seed samples were drawn at tri monthly intervals and evaluated for the following seed and seedling characters upto nine months. The following Physiological and biochemical seed characters were evaluated *viz.*,

Physiological seed characters

Seed Germination (%) for seedling characters, the germination test was conducted using three replications of 100 seeds from each sample in rolled towel papers as per procedure described by ISTA (1999 b).

Vigour index: vigour index were determined by Abdul Baki and Anderson (1973).

In order to calculate Vigour Index formula were used:

V. I. = Germination percentage (Normal seedling) X Seedling length (cm)

Biochemical seed characters

Electrical conductivity (dSm⁻¹)

Pigeonpea seeds were washed with deionised water and the electrical conductivity was measured in duplicate after Presley (1958) with modification as detailed below using Elico conductivity meter (cell constant 1) and expressed in dSm⁻¹. After measuring the EC, the seed leachate was used for the following assessment.

- | | | |
|------------------------|---|--|
| • Leachate amino acids | : | Method described by Moore and Stein, (1948). (µg g ⁻¹) |
| • Lipid Peroxidation | : | Lipid peroxide formation in pigeonpea was studied by the Thiobarbituric acid (TBA) colour reaction outlined by Bernheim <i>et al.</i> , (1948). (OD value) |

The data pertaining to the experiment were subjected to statistical analysis by analysis of variance method as suggested by Gomez and Gomez (1984).

III. RESULTS AND DISCUSSION

The storage of seed assumes paramount importance in a seed production programme. The storability of seed is influenced by several factors. Besides the chemical composition (Maranvilla and Clegg, 1977), seed treatments and the containers used for storage also decide the shelf life of seeds under ambient conditions (Vijayakumar *et al.*, 1991). Hence in the present study the drip fertigation resultant pigeonpea seeds were evaluated initially and at tri monthly intervals up to 9 months through different physiological and biochemical seed quality

parameters. The moisture content of the seed plays a prime role in determination of storability of any seed and it increased with advance in storage period (Copeland and McDonald, 1995). However the fluctuation in moisture content of the present study irrespective of containers was increased to a tune of 9.0 to 9.9 per cent in cloth bag. This slighter increase in seed moisture within nine months might be due to lower level of environmental fluctuations of relative humidity and temperature during the storage period as supported by Agrawal (1995). The seed germination is the basic factor that decides the storability of seeds in all kinds of crop (Abdalla and Roberts, 1969). The germination percentage of the seeds harvested from drip fertigation resultant seeds did show significant difference due to drip fertigation treatment and containers and their interaction effect. Among the seed treatments, the following treatments were better T₄, T₅, T₆, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂ and recorded the maximum germination (89.0 %). However the minimum germination was observed with T₁, T₂, T₃ and T₁₃ (86.0 %). Among the containers, polyethylene bags showed significant maximum germination of 93.0 per cent followed by cloth bag 83.0 per cent (Table 1). Similar results were reported by Renugadevi (2004) reported that clusterbean seeds treated with bavistin @ 2g/kg of seed and packed in 700 gauge polyethylene bag maintained the seed quality characters upto 18 months with 88 per cent germination which was 18 per cent higher than MSCS level of seed germination. The same results were observed by Shenbaganathan (2002) in greengram. Similar results were reported by Gharib *et al.* (2009) who revealed that application of 86 kg N/ha coupled with the 7 or 14 days irrigation intervals resulted in significantly higher seed storability up to 12 month in wheat.

The vigour index values determined were relatively higher in seedlings derived from the following treatments T₄, T₅, T₆, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂ and recorded higher values ranging between (4524 to 4644) vigour index and were all relatively higher compared to T₁, T₂, T₃ and T₁₃. Relatively higher values were recorded by seeds derived from the T₄, T₅, T₆, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂ seed stored in polyethylene bag than those from the seeds stored in cloth bags in the present study (Figure 1). This was in confirmation with the results of Periasamy (1994) who revealed that pigeonpea seeds of ICPH 8 hybrid and its parents dried to 8 per cent moisture content, treated with thiram + BHC 50 % WDP and packed in 700 gauge polyethylene container can be stored upto 8 months with high viability and vigour under ambient condition. The lower value for the vigour parameters of the seeds in cloth bag might be due to increase in moisture content and increased rate of deteriorative process occurring with the senescence of seeds due to ageing in storage.

Seed deterioration alters the semi-permeability properties of the membrane and membrane integrity (Berjack and Villiers, 1972). The electrical conductivity (dSm⁻¹) increased during storage irrespective of containers and seed treatments (0.199 to 0.250 dSm⁻¹). However, T₁, T₂, T₃ and T₁₃ recorded the maximum electrical conductivity values ranging between (0.231

to 0.233 dSm⁻¹). Whereas, minimum electrical conductivity (dSm⁻¹) was observed with T₄, T₅, T₆, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂ (0.222 to 0.224 dSm⁻¹). Among the containers, polyethylene bags showed minimum electrical conductivity (0.219 dSm⁻¹) followed by cloth bag 0.232 dSm⁻¹ (Table 2). Similar results was suggested by Krishna (2006) who reported that RDF treatment recorded significantly lesser electrical conductivity compared to those without fertilizer at the end of storage in rice and also by Tammanagouda (2002) observed that greengram seeds stored in polythene bag recorded lower electrical conductivity with increased germination and seedling length at the end of 10 months. The membrane integrity as reflected through leachate amino acids ranged between 48.14 to 48.78 µg.g⁻¹, lipid peroxidation (0.167 to 0.173) were least affected in treatments T₄, T₅, T₆, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂ compared to T₁, T₂, T₃ and T₁₃. In general, leachate amino acids and lipid peroxidation were relatively higher in cloth bag storage than polyethylene bag (Table 3 & 4). This is in reflection of seed deterioration caused due to impairment of membrane, since ageing of dried seeds in storage is thought to be accompanied by changes in the membrane and alterations in the membrane of aged seeds (Parrish and Leopold, 1978). Several studies support this finding (Punitha, 1996 and Posmyk *et al.*, 2001) Damage to membrane is one of the suggested explanations for loss of viability during ageing (Roberts, 1972).

IV. CONCLUSION

Studies on storability revealed that, Among the 13 treatments, T₄, T₅, T₆, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂ were good storers, while T₁, T₂, T₃ and T₁₃ were medium storers. Whereas seeds stored in polyethylene bag maintained a germination of 93.0 per cent after nine months of storage and the seed quality characters in terms of physiological and biochemical characters degraded with ageing.

REFERENCES

[1] Abdalla, F.H. and E.H. Roberts, 1969. The effect of seed storage conditions on the growth and yield of barley, broad bean and peas. *Annals of Boany*. 33: 169-184.

[2] Abdul Baki, A.A. and J.D. Anderson, 1973. Vigour determination in soybean by multiple criteria. *Crop Science*. 13:63.

[3] Agrawal, R.L., 1995. *Seed Technology*, Oxford and IBH Publishing Co. PVT. Ltd., New Delhi.

[4] Berjack, P. and T.A. Villiers, 1972. Ageing in plant embryos. II. Age induced damage and its repair during early germination. *New Phytology*. 71 : 135-144.

[5] Bernheim, F., Bernheim, M.L.C. and Wilbur, K.M. (1948). The reaction between thiobarbituric acid and the oxidation products of certain lipids. *Journal of Biological Chemistry*. 114: 257-264.

[6] Copeland, L.O. and M.B. Mc Donald. 1995. *Principles of Seed Science and Technology*. Mc Millan Publishing Company, New York.

[7] Gharib, A.F., I.E. Mohamed and M.A. Awad Elkareem, 2009. Effect of irrigation intervals and NPK on yield and seed quality of wheat (*Triticum aestivum* L.). *Sudan Journal of Agricultural Research*. 13: 37-46.

[8] Gomez, K.A. and A.A. Gomez, 1984. *Statistical Procedures for Agricultural Research*. John Wiley and Sons, New York.

[9] ISTA, 1999. *International Rules for Seed Testing*. *Seed Science and Technology*. 13: 209-355.

[10] Krishna, A, 2006. Influence of System of Rice Intensification (SRI) on seed yield, quality and storability of rice, Ph.D. Thesis, University of Agricultural Sciences, Dharwad .

[11] Maity, S., G. Banerjee, B. Chakrabarti and A. Bhattacharjee, 2000. Chemical induced prolongation of seed viability and stress tolerance capacity of mung bean seedlings. *Seed Science and Technology*. 28: 155-162

[12] Marnaville, J.H. and M.D. Clegg, 1977. Influence of seed size and density on germination, seedling emergence and yield of grain sorghum. *Agronomy Journal*. 69: 329-330.

[13] Moore, S. and W.H. Stein, 1948. Photochromic ninhydrin method for use in chromatography of amino acids. *Journal of Biological Chemistry*. 176: 367-388.

[14] Parrish, D.J. and A.C. Leopold, 1978. On the mechanism of ageing of soybean seeds. *Plant Physiology*. 61: 365-368.

[15] Periaswamy, R, 1994. *Seed Technological Studies in the Pigeonpea (Cajanus cajan (L.) Millsp.) Hybrid ICPH 8 and its parental lines*. M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

[16] Posmyk, M.M., F. Corbineau, D. Vinel and D. Come, 2001. Osmoconditioning reduces physiological and biochemical damage induced by chilling in soybean seeds. *Plant Physiology*. 111: 473-482.

[17] Powell, A.A., L.J. Yule, H.C. Jing, S.P.C. Groot, R.J. Bino and H.W. Pritchard, 2000. The influence of aerated hydration seed treatment on seed longevity as assessed by the viability equations. *Journal of experimental Botany*. 51: 2031-2043

[18] Presley, J.T, 1958. Relation of protoplast permeability cotton seed viability and predisposition to seedling diseases. *Plant Disease*. 42 : 852.

[19] Punitha, S.P, 1996. *Halogenation Treatment to Control Seed Deterioration in Vegetable Crops*. M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University., Coimbatore.

[20] Reddy, S. A, 1985. *Studies on Seed Viability and Vigour in cultivars of Gossypium hirsutum L., G. barbadense L.* M.Sc. (Ag) Thesis, Tamil Nadu Agricultural University, Coimbatore.

[21] Renugadevi, J, 2004. *Investigations on Seed Management, production, processing and storage of clusterbean (Cyamopsis tetragonoloba (L.) Taub.)*, Ph.D. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

[22] Roberts, E.H, 1972. *Viability of Seed* (ed. Roberts, E.H. Chapman and Hall, London), Pp. 14-58.

[23] Shenbaganathan, A, 2002. *Seed Management Techniques for Quality Seed Production of Greengram (vigna radiata l.wilczek) Cv. Co 6*. M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

[24] Tammanagouda, P, 2002. *Influence of Organics on Seed yield, quality and storability studies in greengram Cv. Chinamung*. M.Sc. (Ag.) Thesis, University of Agricultural Science, Dharwad.

[25] Vijayakumar, A., V. Palanisamy, T. Jayaraj and R. Arumugam, 1991. Effect of seed treatments and containers on the storability of onion seeds. *South Indian Hort.*, 39: 296-299.

[26] Wilson, D.O. and M.B. McDonald, 1986. The lipid peroxidation model of seed ageing. *Seed Sci., & Technol.*, 16: 115-121.

Wittington, W.J. (1978). Genetic aspects of final emergence and rate of emergence, *Seed Abstract*, 2: 167.

[27] Zhang, Q.C., G.H. Zhanq and J. Lin, 1989. Effect of iodination on resistance of soybean seeds to imbibitional chilling injury. *Chinese Sci. Bull.*, 34: 1669-1668.

AUTHORS

First Author – S. Manikandan, Senior Research Fellow, Department of Seed Science and Technology, Agricultural College and Research Institute (Tamil Nadu Agricultural University), Madurai - 625 104, Tamil Nadu, India.
Second Author – K. Sivasubramaniam, DEAN, College of Agricultural Technology, Theni – 625 562, Tamil Nadu, India.
Correspondence Author – S. Manikandan, Email-vsmanister@gmail.com

Table 1. Influence of pigeonpea seed and containers on germination (%) during storage

Treatment	Container (C) and storage periods in months (P)									
	Cloth bag (C ₁)					Polyethylene bag (C ₂)				
	P ₁	P ₂	P ₃	P ₄	Mean	P ₁	P ₂	P ₃	P ₄	Mean
T ₁ (F ₁ FS ₁)	93	87	77	65	81	93	92	90	88	91
T ₂ (F ₁ FS ₂)	93	87	77	65	81	93	92	90	88	91
T ₃ (F ₁ FS ₃)	93	87	77	65	81	93	92	90	88	91
T ₄ (F ₂ FS ₁)	96	90	80	68	84	96	95	93	91	94
T ₅ (F ₂ FS ₂)	96	90	80	68	84	96	95	93	91	94
T ₆ (F ₂ FS ₃)	96	90	80	68	84	96	95	93	91	94
T ₇ (F ₃ FS ₁)	96	90	80	68	84	96	95	93	91	94
T ₈ (F ₃ FS ₂)	96	90	80	68	84	96	95	93	91	94
T ₉ (F ₃ FS ₃)	96	90	80	68	84	96	95	93	91	94
T ₁₀ (F ₄ FS ₁)	96	90	80	68	84	96	95	93	91	94
T ₁₁ (F ₄ FS ₂)	96	90	80	68	84	96	95	93	91	94
T ₁₂ (F ₄ FS ₃)	96	90	80	68	84	96	95	93	91	94
Control	93	87	77	65	81	93	92	90	88	91
Mean	95	89	79	67	83	95	94	92	90	93
Level of significance										
	P	C	T	T X P	P X C	T X C	T X P X C			
SEd	0.425	0.300	0.765	1.531	0.600	1.082	2.165			
CD(P=0.05)	0.842**	0.595**	1.518**	3.036*	1.191**	NS		NS		

Table 2. Influence of pigeonpea seed and containers on Electrical conductivity (dSm^l) during storage

Treatment	Container (C) and storage periods in months (P)									
	Cloth bag (C ₁)					Polyethylene bag (C ₂)				
	P ₁	P ₂	P ₃	P ₄	Mean	P ₁	P ₂	P ₃	P ₄	Mean
T ₁ (F ₁ FS ₁)	0.210	0.225	0.245	0.268	0.237	0.210	0.219	0.230	0.239	0.225
T ₂ (F ₁ FS ₂)	0.212	0.226	0.246	0.269	0.238	0.212	0.221	0.232	0.241	0.227
T ₃ (F ₁ FS ₃)	0.212	0.225	0.245	0.268	0.238	0.212	0.221	0.232	0.241	0.227
T ₄ (F ₂ FS ₁)	0.194	0.220	0.240	0.263	0.229	0.194	0.212	0.223	0.232	0.215
T ₅ (F ₂ FS ₂)	0.198	0.221	0.241	0.264	0.231	0.198	0.212	0.222	0.231	0.216
T ₆ (F ₂ FS ₃)	0.193	0.223	0.238	0.261	0.229	0.193	0.213	0.224	0.233	0.216
T ₇ (F ₃ FS ₁)	0.190	0.221	0.241	0.264	0.229	0.190	0.214	0.224	0.233	0.215
T ₈ (F ₃ FS ₂)	0.194	0.222	0.242	0.265	0.231	0.194	0.215	0.226	0.235	0.218
T ₉ (F ₃ FS ₃)	0.193	0.221	0.242	0.265	0.230	0.193	0.216	0.224	0.233	0.217
T ₁₀ (F ₄ FS ₁)	0.194	0.221	0.241	0.264	0.230	0.194	0.212	0.223	0.232	0.215
T ₁₁ (F ₄ FS ₂)	0.192	0.223	0.242	0.265	0.231	0.192	0.213	0.224	0.233	0.216
T ₁₂ (F ₄ FS ₃)	0.194	0.221	0.241	0.264	0.230	0.194	0.216	0.227	0.236	0.218
Control	0.213	0.226	0.246	0.269	0.239	0.213	0.222	0.235	0.242	0.228
Mean	0.199	0.223	0.242	0.265	0.232	0.199	0.216	0.227	0.235	0.219
Level of significance										
	P	C	T	T X P	P X C	T X C	T X P X C			
SEd	0.003	0.002	0.005	0.009	0.004	0.006	0.013			
CD(P=0.05)	0.005*	0.004**	0.009**	0.018*	0.007**	NS		NS		

Table 3. Influence of pigeonpea seed and containers on Leachate aminoacids ($\mu\text{g.g}^{-1}$) during storage

Treatment	Container (C) and storage periods in months (P)									
	Cloth bag (C ₁)					Polyethylene bag (C ₂)				
	P ₁	P ₂	P ₃	P ₄	Mean	P ₁	P ₂	P ₃	P ₄	Mean
T ₁ (F ₁ FS ₁)	45.23	48.93	51.15	53.21	49.63	45.23	49.72	48.87	51.40	48.81
T ₂ (F ₁ FS ₂)	45.38	49.08	51.30	53.36	49.78	45.38	49.83	48.93	51.55	48.92
T ₃ (F ₁ FS ₃)	45.45	49.15	51.37	53.43	49.85	45.45	49.90	49.00	51.62	48.99
T ₄ (F ₂ FS ₁)	44.52	48.22	50.44	52.13	48.83	44.52	49.07	48.07	50.69	48.09
T ₅ (F ₂ FS ₂)	44.45	48.15	50.37	52.43	48.85	44.45	48.90	48.00	50.62	47.99
T ₆ (F ₂ FS ₃)	44.20	47.88	50.12	52.18	48.60	44.20	48.75	47.96	50.37	47.82
T ₇ (F ₃ FS ₁)	44.90	48.60	50.82	52.89	49.30	44.90	49.35	48.45	50.34	48.26
T ₈ (F ₃ FS ₂)	44.27	47.97	50.18	52.26	48.67	44.27	48.80	47.98	50.44	47.87
T ₉ (F ₃ FS ₃)	44.16	47.86	50.15	52.15	48.58	44.16	48.61	47.71	50.33	47.70
T ₁₀ (F ₄ FS ₁)	44.37	48.07	50.28	52.36	48.77	44.37	48.82	47.92	50.54	47.91
T ₁₁ (F ₄ FS ₂)	44.72	48.40	50.61	52.69	49.11	44.72	49.15	48.25	50.87	48.25
T ₁₂ (F ₄ FS ₃)	44.52	48.22	50.43	52.51	48.92	44.52	49.02	48.07	50.69	48.08
Control	45.37	49.07	51.28	53.36	49.77	45.37	49.82	48.92	51.54	48.91
Mean	44.73	48.43	50.65	52.69	49.13	44.73	49.21	48.32	50.85	48.28
Level of significance										
	P	C	T	T X P	P X C	T X C	T X P X C			
SEd	0.228	0.161	0.411	0.821	0.322	0.581	1.161			
CD(P=0.05)	0.452**	0.319**	0.814**	1.628*	0.639**	1.151*	NS			

Table 4. Influence of pigeonpea seed and containers on Lipid peroxidation (OD value) during storage

Treatment	Container (C) and storage periods in months (P)									
	Cloth bag (C ₁)					Polyethylene bag (C ₂)				
	P ₁	P ₂	P ₃	P ₄	Mean	P ₁	P ₂	P ₃	P ₄	Mean
T ₁ (F ₁ FS ₁)	0.144	0.167	0.213	0.239	0.191	0.144	0.160	0.187	0.212	0.176
T ₂ (F ₁ FS ₂)	0.144	0.167	0.213	0.239	0.191	0.144	0.160	0.187	0.210	0.175
T ₃ (F ₁ FS ₃)	0.145	0.168	0.215	0.240	0.192	0.145	0.161	0.188	0.213	0.177
T ₄ (F ₂ FS ₁)	0.137	0.160	0.195	0.232	0.181	0.137	0.153	0.180	0.193	0.166
T ₅ (F ₂ FS ₂)	0.134	0.157	0.192	0.229	0.178	0.134	0.150	0.177	0.190	0.163
T ₆ (F ₂ FS ₃)	0.137	0.160	0.195	0.232	0.181	0.137	0.153	0.180	0.193	0.166
T ₇ (F ₃ FS ₁)	0.136	0.159	0.194	0.231	0.180	0.136	0.152	0.179	0.192	0.165
T ₈ (F ₃ FS ₂)	0.131	0.154	0.189	0.226	0.175	0.131	0.147	0.174	0.187	0.160
T ₉ (F ₃ FS ₃)	0.134	0.157	0.192	0.229	0.178	0.134	0.150	0.177	0.190	0.163
T ₁₀ (F ₄ FS ₁)	0.135	0.158	0.193	0.230	0.179	0.135	0.151	0.178	0.191	0.164
T ₁₁ (F ₄ FS ₂)	0.136	0.159	0.194	0.231	0.180	0.136	0.152	0.179	0.192	0.165
T ₁₂ (F ₄ FS ₃)	0.134	0.157	0.192	0.229	0.178	0.134	0.150	0.177	0.190	0.163
Control	0.145	0.168	0.213	0.240	0.192	0.145	0.161	0.188	0.212	0.177
Mean	0.138	0.161	0.199	0.233	0.183	0.138	0.154	0.181	0.197	0.167
Level of significance										
	P	C	T	T X P	P X C	T X C	T X P X C			
SEd	0.0003	0.0002	0.0005	0.0010	0.0004	0.0007	0.0014			
CD(P=0.05)	0.0006**	0.0004**	0.0010**	0.0020**	0.0008**	0.0014**	0.0028**			

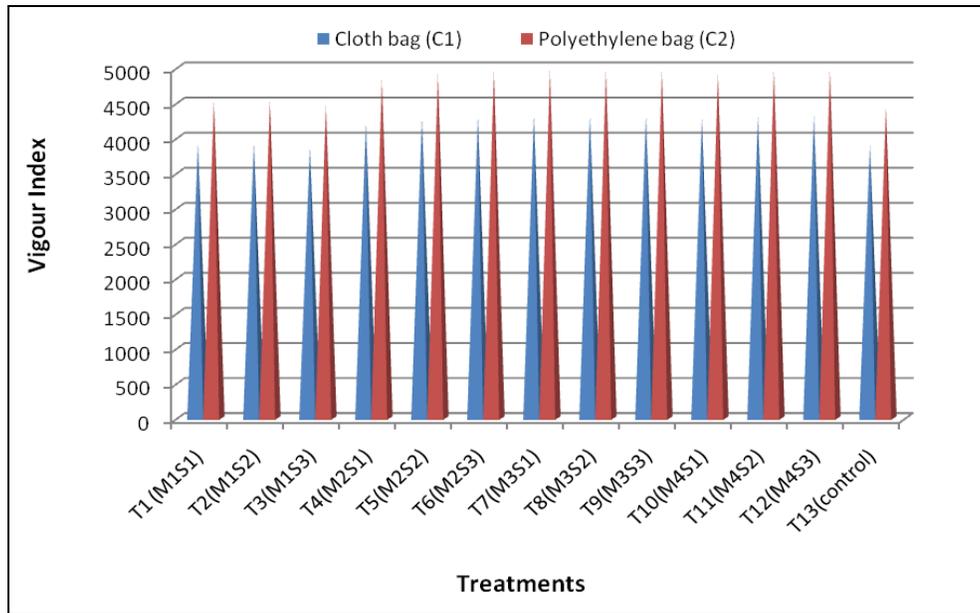


Figure 1. Influence of pigeonpea seed and containers on vigour index during storage

AT Commands

Meraj Alam

Syscom Corporation Limited

Abstract- In this paper, AT Command, which is used to instruct the modem, is discussed. AT Command as a Proactive Command (command that is being executed by SIM) will also be discussed in this paper. In addition, several applications that are being used to instruct the modem are discussed.

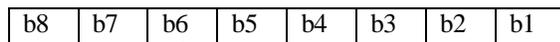
Index Terms- Attention (AT), General Packet Radio Service (GPRS), International Mobile Equipment Identity (IMEI), International Mobile Subscriber Identity (IMSI), Subscriber Identity Module (SIM), Short Message Service (SMS), 3rd Generation Partnership Project (3GPP), Protocol Data Unit (PDU), COMmunication Port (COM Port).

I. INTRODUCTION

The abbreviation for AT is “Attention”. AT Commands are basically the commands to instruct the Modem. Due to this reason, AT commands are also known as Modem Commands. The command line starts with “AT” or “at”. Now, we have variety of GSM/GPRS modems and the modem enabled mobile phones. So, with the help of AT Commands we can instruct/control the behavior or change few characteristics of mobile phones. In this paper, the various tasks that can be achieved using AT commands with a GPRS/GSM modem or Mobile Phones will be described. Remember one thing that Mobile Phone manufacturers usually do not implement all AT Commands, Command Parameters and Parameter Values in their Mobile Phones. Also, the behavior of the implemented AT Commands may be different from that defined in standard. In general, GSM/GPRS modems designed for wireless applications have better support of AT commands than ordinary mobile phones. In addition, some AT commands require the support of mobile network Operators for network related commands such as Send SMS, etc.

II. MOBILE PHONES AND AT COMMANDS

There are several kinds of mobile phones available in the market that supports AT commands. To know whether AT command is supported by the mobile phone, there is a need to understand the command known as Terminal Profile. Terminal Profile is issued by the mobile phones to inform SIM about what all capability the mobile phone has. The eighth byte in Terminal Profile command contains the information of AT command as shown below: (For in-depth knowledge of Terminal Profile command refer [2])



III. USE OF AT COMMAND

Here are some of the common tasks that can be performed using AT commands with a GSM/GPRS modem or modem enabled mobile phone which are as below:

1. Get basic information about the mobile phone. For example, name of manufacturer, model number, IMEI number and software version.
2. Get basic information about the subscriber. For example, MSISDN and IMSI number.
3. Get the current status of the mobile phone or GSM/GPRS modem. For example, mobile phone activity status, mobile network registration status, radio signal strength, battery charge level and battery charging status.

4. Data connection or Voice connection to a remote modem.
5. Read, Write, Delete and Send SMS and get the notifications on receiving the new SMS.
6. Read, Write and Search phonebook entries.
7. Get or change the configuration settings of the mobile phone or GSM/GPRS modem. For example, SMS center address and storage of SMS messages whether SIM or Phone.

Apart from the above tasks, there are lots of more tasks that can be performed using AT Commands. For Example, Security Related Tasks, Change the Display Screen of Mobile Phones (Where should Time, Operator Name get displayed), etc.

IV. TYPES OF AT COMMAND

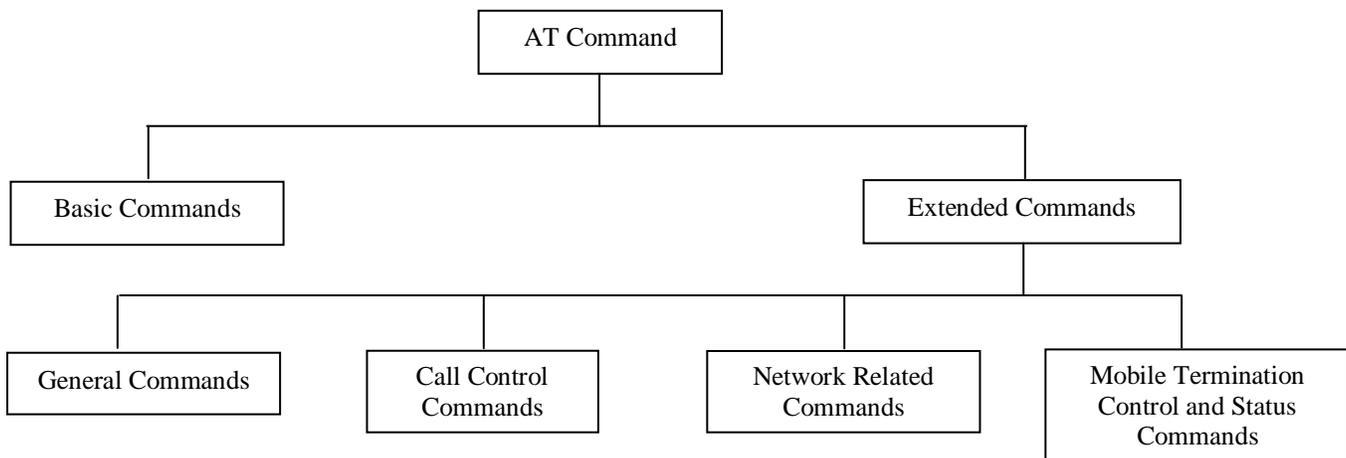
There are so many discrepancies in types of AT Command and their names. But if we analyze on broader end; AT Commands are broadly differentiated in two categories as below:

1. Basic Commands
2. Extended Commands

Basic Commands are those commands that do not start with '+'. For Example, ATD^{Note} (For Dial), ATA^{Note} (For Answer).

Extended Commands are those commands that starts with '+'. For Example, AT+CMGS^{Note} (For Send SMS). All GSM AT Commands are Extended Commands.

Further, Extended Commands are more classified in various categories that are described diagrammatically as below:



Note: “AT” Command Line Character is not the part of Command. It’s just to identify that these are AT commands. AT command line prefix is to notify the software that the commands to be executing is a set of AT commands or Modem Commands. Windows has provided the basic program to execute the AT commands i.e. Windows Hyper Terminal.

V. SYNTAX OF AT COMMAND

In 3GPP Specification of AT Command, all commands have been written in uppercase letters. However, many GSM/GPRS modems and mobile devices support uppercase or lowercase letters i.e. case insensitive. So, case sensitivity of AT Commands depends on the manufacturer of the mobile device.

The General syntax of AT Commands is as described below:

1. All command lines must start with “AT” and end with a carriage return (<CR>) character.
 - a. For Example: AT+CMGL<CR> (To list all unread message)
2. A command line can contain more than one AT command. Only the first AT command should be prefixed with “AT”. There should be semi colon to separate the two commands.
 - a. For Example: AT+CMGL;+CGMI<CR> (To list all unread message, get the manufacturer name of the mobile device)
3. String must be enclosed between double quotes.
 - a. For Example: AT+CMGL=“ALL” <CR> (To read all the SMS)
4. Information responses and result codes always start and end with a carriage return character and a linefeed character.
 - a. For Example: After sending the command line as AT+CGMI<CR>, the mobile device will send the response as
<CR><LF>Nokia<CR><LF>
<CR><LF>OK<CR><LF>

On any of the Hyper Terminal Program, it will look like as:

```
AT+CGMI -> Command Line
Nokia -> Information Response
OK -> Result Code
```

The result code “OK” treats as the end of the response. It indicates no more data will be send from the mobile device.

VI. ERROR CODES

Error Codes are the final result codes through which Mobile device informs the cause of failure of the commands. There is an AT Command through which you can bind any mobile device to throw the error code on occurrence of the failure of command.

There are two types of Error Codes are as follows:

1. CME Error Codes – GSM Device Error Codes
2. CMS Error Codes – GSM Network Related Codes

The Command which is used to set the error code output is AT+CMEE which comprise of three possible values as below:

1. 0, that means +CME Error shall not be used.
2. 1, that means Error will display as numeric value.
3. 2, that means Error will display as verbose (i.e. statement).

Below are the illustrations of different cases (Different values of +CMEE command) on +CGMI Command:

Case 0:

```
AT+CMEE=0
OK
AT+CGMI
ERROR
```

Case 1:

```
AT+CMEE=1
OK
AT+CGMI
+CME ERROR: 1
```

Case 2:

```
AT+CMEE=2
OK
AT+CGMI
+CME ERROR: no connection to phone
```

Below are the Error Codes and their meaning:

- CME ERROR: 0 Phone failures
- CME ERROR: 1 No connection to phone
- CME ERROR: 2 Phone adapter link reserved
- CME ERROR: 10 SIM not inserted
- CME ERROR: 11 SIM PIN required
- CME ERROR: 12 SIM PUK required
- CME ERROR: 13 SIM failures
- CME ERROR: 14 SIM busy
- CME ERROR: 15 SIM wrong

VII. AT COMMAND AS PROACTIVE COMMAND

AT Commands as Proactive Command are mentioned in 3GPP standard, refer [2] for the structure of proactive command. The “AT Command String” is exactly configured as discussed above and can be referenced from [1].

VIII. SEND SMS APPLICATION USING AT COMMAND

By default, Windows has provided software named as “Windows Hyper Terminal” through which you can send AT command to the Modem or Modem enabled device. You can also use your own application for Sending AT Command that will customize as per the requirement. I am going to show a sample application that will be used to broadcast SMS to the various subscribers.

This application has been developed in JAVA that will Send SMS to all of the numbers provided in an excel sheet as below:

	A	B	C	D
1	Contact Name	Contact Number		
2	Meraj Alam	1111111111		
3	Prem Kumar	2222222222		
4	Bharat Bhanjana	3333333333		
5				
6				
7				
8				

First of all, we need to import package “javax.comm” which is not available with JDK. This package contains several APIs that is used to interact with the COM port available in the system. This package can be downloaded from net as per the instructions given:

Next step is to get all the available ports on your system as:

```
Enumeration ports = CommPortIdentifier.getPortIdentifiers();  
while (ports.hasMoreElements()) { }
```

Get the serial port from the available port list and execute the commands on the port that your device has been connected as:

```
If (port.getPortType() == CommPortIdentifier.PORT_SERIAL )
```

Initialize the Serial Port Object as:

```
serialPort = (SerialPort) port.open(“AT Command App”, 2000);  
serialPort.setSerialPortParams(2400, SerialPort.DATABITS_8, SerialPort.STOPBITS_1, SerialPort.FLOWCONTROL_NONE);
```

Get the Output Stream object for writing to the port as:

```
outputStream = serialPort.getOutputStream();
```

Send the AT Command to output Stream as:

```
String data = “AT+CMGS=\\” + data + “\\”\r\n”;  
// data is the variable that contains phone number from excel sheet.  
outputStream.write(data.toString().getBytes());
```

```
String data = "Hello " + data + '\032';  
// data is the variable that contains name from excel sheet.  
// '\032' is the character code for CTRL-Z.  
outputStream.write(data.toString().getBytes());
```

After sending the AT Command as output stream, get the Input Stream Object to read the response from port that was given by mobile device. This application can be customized further to have the pre defined message column in excel sheet. This application can be used to send invitation across group of people in one click.

IX. CONCLUSION

So, we can implement various applications that can control the modem behavior, execute various functionalities related to GSM domain, Network, etc using AT Commands. Using AT as proactive command, we can also build various applications on SIM card that can instruct modem enabled phone to execute various tasks such as change the vibrator mode to ringer mode (this application is useful in case we forget where we have kept our handset and it is on vibrating mode), change the display characteristics of Handset, access all the messages that is stored on phone memory or SIM memory, etc. As it is evident from the above research that AT commands can be useful to built several applications and hence I recommend that Mobile manufacturers should consider more AT command set in the mobile terminals.

ACKNOWLEDGMENT

I would like to acknowledge my colleagues for supporting and encouraging me throughout the course work.

REFERENCES

- [1] 3GPP TS 27.007 V6.3.0 (2003-06) 3rd Generation Partnership Project; Technical Specification Group Terminals; AT command set for User Equipment (UE).
- [2] 3GPP TS 11.14 version 8.18.0; Digital cellular telecommunications system (Phase 2+); Specification of the SIM Application Toolkit (SAT) for the Subscriber Identity Module - Mobile Equipment (SIM-ME) interface.

AUTHORS

First Author – Meraj Alam, Experience: Currently working with Syscom Corporation Ltd, a leading telecom company dealing in SIM and SMART cards, **Email Address:** meraj.bpositive.alam1@gmail.com

Buckling Analysis of Cold Formed Steel for Beams

Prakash M. Mohite *, Aakash C. Karoo **

* Associate Professor, Department of Civil Engineering, Rajarambapu Institute of Technology, Islampur, India

** PG Scholar, Department of Civil Engineering, Rajarambapu Institute of Technology, Islampur, India

Abstract- Cold formed steel are nowadays used for building construction especially non-load bearing partition, curved walls, etc due to its flexural strength and good appearance. The cold formed steel enhances the mean yield stress by 15% to 30% as compared to hot rolled steel. In this paper detailed parametric and comparative study of cold formed steel sections by different codes is carried out for prediction of flexural strength of beams. Various codes predict different strength. The flexural strength of cold formed steel beam is carried out and presented using CUFSM software which uses Direct Strength Method for prediction of flexural strength and this flexural strength is compared with IS 801-1975 and experimental results.

Index Terms- Cold formed steel, flexural strength, Direct Strength Method

I. INTRODUCTION

Cold formed steel are also called light gauge steel and are cold formed from steel or strips. Cold-formed sections are produced by bending and shaping flat sheet steel at ambient temperatures. The thickness of steel sheet used in cold formed construction is usually 1 to 3 mm. Much thicker material up to 8 mm can be formed if pre-galvanized material is not required for the particular application. Normally, the yield strength of steel sheets used in cold-formed sections is at least 280 N/mm², although there is a trend to use steels of higher strengths, and sometimes as low as 230 N/mm².

For the determination of member elastic buckling load/moment, CUFSM software (Schafer 2006; Schafer and Adány 2006) is mainly used which uses finite strip method for calculation and it gives nearer to experimental results as compared to other methods. However, currently, FSA can only handle accurately single-span members (mostly simply supported) subjected to uniform internal force and moment diagrams. Conventional Finite Strip Method (FSM) provides a means to examine all the possible instabilities in a cold-formed steel member under longitudinal stresses (axial, bending, or combinations thereof). Various types of buckling may occur such as local buckling, distortional buckling, flexural-torsional buckling, lateral-torsional buckling as shown in Figure 1.

In Figure 1, the first minimum (Point 1) is a local buckling mode, which involves buckling of the web, compression flange, and lip stiffener. The second minimum (Point 2) is the flange distortional buckling mode and involves the rotation of the compression lip-flange component about the web-flange junction. At longer wavelengths where the purlin is unrestrained, a flexural-torsional or lateral buckling mode occurs (Point 3). However, if the tension flange is torsionally restrained, then a lateral distortional buckling mode may take place, as shown by Point 4 (Hancock 1998). This lateral distortional buckle strength is dependent on the degree of torsional restraint provided to the tension flange (Hancock 1998).

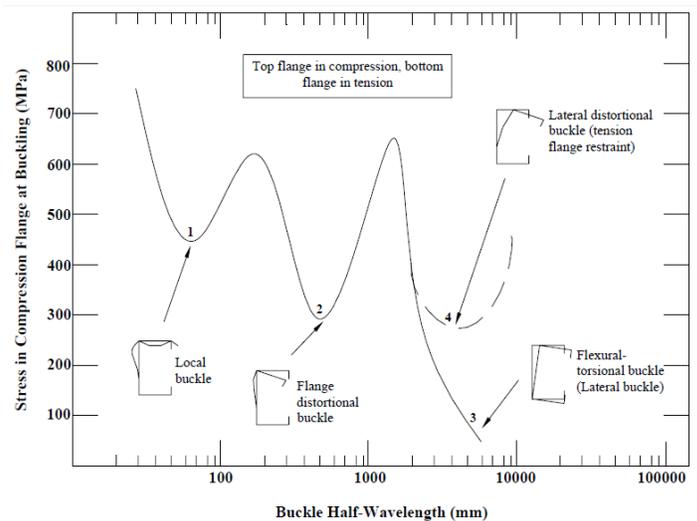


Figure 1: Buckling Modes Subject to a C-Purlin for Major Axis Bending.

II. OBJECTIVES

The objectives of this paper are as follows:

1. To study various modes of buckling occurring in a cold formed steel members when subjected to flexural loading.

2. To calculate finite strip solution for buckling class such as global, distortional or local buckling using CUFSM software.
3. Hence, after calculating the values for loading by using CUFSM software, obtaining the values of flexural strength by Direct Strength Method.
4. To study, design and compare the values of flexural strength by Direct Strength Method as well as by Indian Standard (IS 801-1975) code and by experimental value.

III. DESIGN FOR FLEXURAL STRENGTH OF BEAM

Review of Codal Provisions:

The following codes of practices are studied to know how these limit states are handled :

- 1) Direct Strength method.
- 2) IS Code 801-1975 of practice for use of cold formed light gauge steel structural members in general building construction.

Different countries use different design methods for the light gauge cold formed steel structures. India uses IS: 801-1975 which is based on allowable/working stress method of design.

❖ **Considering an example of a C-lipped section of 21.71446 cm X 6.2966 cm X 0.18034 cm with yield stress of 404.7222 N/mm²**

- A. Computation as per IS code 801-1975 of practice for use of Cold formed light gauge steel structural members in general building construction:

Material Properties : yield stress $f_y = 404.7222 \text{ N/mm}^2$

- i. Computation of Sectional Properties:

Depth $d = 217.1446 \text{ mm}$
 Width $w = 62.966 \text{ mm}$
 Depth of lip $D = 24.4942 \text{ mm}$
 Thickness $t = 1.8034 \text{ mm}$
 Area $A = 708.64 \text{ mm}^2$
 Span of length $L = 1000 \text{ mm}$
 Centroid: CG of section : $X_{cg} = 18.083 \text{ mm}$
 $Z_{cg} = 108.572 \text{ mm}$
 Moment of inertia : $I_{xx} = 5.0513 \times 10^6 \text{ mm}^4$
 $I_{zz} = 0.4250 \times 10^6 \text{ mm}^4$

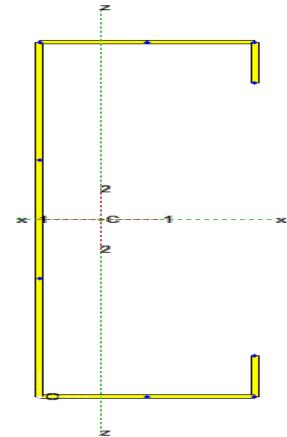


Figure 2: C lipped section

- ii. Computation of effective width:

Checking of above section as per clause 5.2.2.1 IS 801-1975 (Page No: 6):

Effective width calculation of compression elements :

Flange is fully effective if $\frac{w}{t} \leq \left(\frac{w}{t}\right)_{lim}$

$$\text{Hence } \frac{w}{t} = \frac{6.2966}{0.18034} = 34.9151$$

$$\left(\frac{w}{t}\right)_{lim} = \frac{1435}{\sqrt{f_y}} = \frac{1435}{\sqrt{404.7222}} = 71.330$$

$$\text{Hence } \frac{w}{t} < \left(\frac{w}{t}\right)_{lim} .$$

Therefore Entire area is effective.

- iii. Determination of safe load:

$$\text{Section modulus } S_e = \frac{I_{xx}}{Z_{cg}} = \frac{5.0513 \times 10^6}{108.572} = 46525.7 \text{ mm}^3$$

Allowable resisting moment = $S_e \times f_y$

$$= 46525.7 \times 404.7222$$

$$M = 18.8 \times 10^6 \text{ Nmm}$$

Let w be the load in N/mm

$$\frac{w \times 1000^2}{8} = 18.8 \times 10^6$$

$$w = 150.4 \text{ N/mm}$$

iv. Check for web shear :

$$\text{Maximum Shear force} = V = \frac{150.4 \times 1000}{2} = 75.2 \times 10^3 \text{ N}$$

$$\text{Maximum average shear stress } F_{\max} = \frac{V}{A} = \frac{75.2 \times 10^3}{708.64} = 106.118 \text{ N/mm}^2$$

$$\frac{h}{t} = \frac{217.1446}{1.8034} = 120.4084$$

$$\frac{4590}{\sqrt{f_y}} = \frac{4590}{\sqrt{404.7222}} = 228.1571$$

As per clause 6.4.1 IS 801-1975 (Page No: 15) :

$$\text{Since } \frac{h}{t} < \frac{4590}{\sqrt{f_y}}$$

$$\text{Therefore the gross area of a flat web} = F_v = \frac{1275\sqrt{f_y}}{\frac{h}{t}} = \frac{1275\sqrt{404.7222}}{120.4084}$$

$$F_v = 213.025 \text{ N/mm}^2$$

F_v must not be greater than $F_{v_{\max}} = 0.4f_y = 0.4 \times 404.7222$

$$F_{v_{\max}} = 161.88 \text{ N/mm}^2$$

Hence $F_v = F_{v_{\max}} = 161.88 \text{ N/mm}^2$.

Thus, $F_v = F_{v_{\max}} = 161.88 \text{ N/mm}^2$ this is greater than the maximum Average shear stress of $F_{\max} = 106.118 \text{ N/mm}^2$. Thus the beam is therefore safe in shear.

v. Check for bending compression in web :

As per clause 6.4.2 IS 801-1975 (Page No: 16) :

Actual compression stress at junction of flange and web :

$$\begin{aligned} f_{bw} &= f_c \times \frac{62.966 - 1.8034}{62.966} \\ &= 0.4 \times f_y \times \frac{62.966 - 1.8034}{62.966} \\ &= 235.878 \text{ N/mm}^2 \end{aligned}$$

Permissible:

$$\begin{aligned} F_{bw} &= \frac{36560000}{\left(\frac{h}{t}\right)^2} \text{ kg/cm}^2 \\ &= \frac{3585311.24}{\left(\frac{h}{t}\right)^2} \text{ N/mm}^2 \\ &= 247.29 \text{ N/mm}^2 \end{aligned}$$

Since $F_{bw} > f_{bw}$. Hence Safe in bending.

vi. Combined Bending and Shear Stresses in Webs :

As per clause 6.4.2.3 IS 801-1975 (Page No: 16) :

$$\sqrt{\left(\frac{f_{bw}}{F_{bw}}\right)^2 + \left(\frac{F_{\max}}{F_v}\right)^2} \leq 1$$

where, f_{bw} = actual compression stress at junction of flange and web;

$$F_{bw} = \frac{3585311.24}{\left(\frac{h}{t}\right)^2} \text{ N/mm}^2$$

F_{\max} = actual average shear stress, that is, shear force per web divided by webs area;

F_v = allowable shear stress, except that the limit of $0.4f_y$, shall not apply.

$$\sqrt{\left(\frac{235.875}{247.29}\right)^2 + \left(\frac{106.118}{213.025}\right)^2} = 0.9934$$

Since Combined Bending and Shear Stresses in Webs is less than unity. Hence the section is safe.

vii. Determination of deflection :

$$\text{Deflection } \delta = \frac{5wL^4}{384EI} < \frac{L}{325}$$

where $w = 150.4 \text{ kN/m} = 150.4 \text{ N/mm}$

$$L = 1000 \text{ mm}$$

$$E = 2.033 \times 10^5 \text{ N/mm}^2$$

$$I_{xx} = 505.1343 \times 10^4 \text{ mm}^4$$

$$\text{Hence } \delta = \frac{5 \times 150.4 \times (10^3)^4}{384 \times 2.033 \times 10^5 \times 505.1343 \times 10^4} = 1.9096 \text{ mm.}$$

Permissible :

$$\frac{L}{325} = \frac{1000}{325} = 3.076 \text{ mm.}$$

Hence safe.

B. Computation as per Direct Strength method (DSM) :

i. Check for Section as per AISI-S100-07:

Material properties is same as in IS 801-1975 calculations.

The following Checks must be satisfied for the C section as per AISI-S100-07

Section 1.1.1.2 :

$$\frac{h_o}{t} = \frac{217.446}{1.8034} = 120.5755 < 321. \quad \text{OK.}$$

$$\frac{t}{b_o} = \frac{1.8034}{62.966} = 34.9151 < 75. \quad \text{OK.}$$

$$\frac{t}{D} = \frac{1.8034}{24.4942} = 13.5822 < 34. \quad \text{OK.}$$

$$\frac{h_o}{b_o} = \frac{217.1446}{62.966} = 3.4486 > 1.5 \quad \text{and} < 17 \quad \text{OK.}$$

$$\frac{D}{b_o} = \frac{24.4942}{62.966} = 0.3890 < 0.70 \quad \text{OK.}$$

$$\frac{E}{f_y} = \frac{2.033 \times 10^5}{404.7222} = 502.3198 > 421 \quad \text{OK.}$$

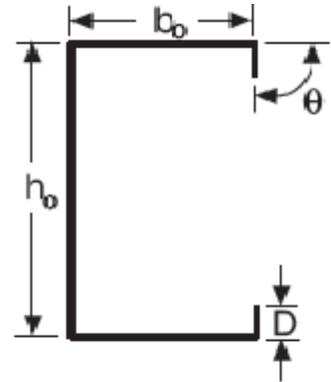


Figure 3: C lipped section notations

ii. Calculation of Yield moment and Critical Elastic Buckling Moment:

From CUFSM software assigning the value for $f_y = 404.7222 \text{ N/mm}^2$, we get, Yield Moment $M_y = 18.82987 \times 10^6 \text{ Nmm}$.

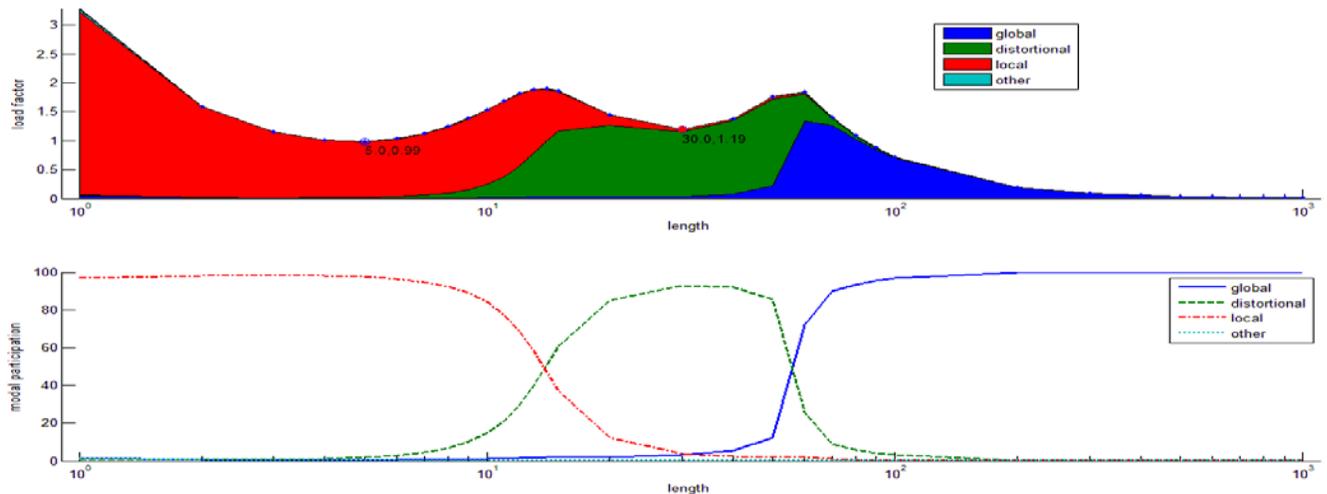


Figure 4: Graph of load factor vs length.

From Figure 4 we obtain the load factors as:

$$\text{Local Buckling} = \frac{M_{crl}}{M_y} = 0.98606$$

$$\text{Distortional Buckling} = \frac{M_{crd}}{M_y} = 1.1922$$

$$\text{Global Buckling} = \frac{M_{cre}}{M_y} = 0.71685$$

$$\text{Hence Critical Elastic Local Buckling Moment } M_{crl} = 0.98606 \times M_y = 0.98606 \times 18.82987 \times 10^6$$

$$= 18.56738 \times 10^6 \text{ Nmm.}$$

$$\begin{aligned} \text{Critical Elastic Distortional Buckling Moment } M_{crd} &= 1.1922 \times M_y \\ &= 1.1922 \times 18.82987 \times 10^6 \\ &= 22.44897 \times 10^6 \text{ Nmm.} \end{aligned}$$

$$\begin{aligned} \text{Critical Elastic lateral torsional Buckling Moment } M_{cre} &= 0.71685 \times M_y \\ &= 0.71685 \times 18.82987 \times 10^6 \\ &= 13.49819 \times 10^6 \text{ Nmm.} \end{aligned}$$

iii. Calculation of Nominal Flexural Strength :

As per AISI-S100-07 Section 1.2.2 Nominal Flexural Strength of beam is minimum of local, distortional and lateral torsional buckling and is calculated as follows:

a. Nominal flexural strength for Lateral-torsional buckling per AISI-S100-07 Section 1.2.2.1 :

The nominal flexural strength, M_{ne} , for lateral-torsional buckling shall be calculated in accordance with the following:

$$\begin{aligned} \text{for } M_{cre} < 0.56M_y \\ M_{ne} &= M_{cre} \end{aligned} \quad (Eq. 1.2.2-1)$$

$$\begin{aligned} \text{for } 2.78M_y \geq M_{cre} \geq 0.56M_y \\ M_{ne} &= \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \end{aligned} \quad (Eq. 1.2.2-2)$$

$$\begin{aligned} \text{for } M_{cre} > 2.78M_y \\ M_{ne} &= M_y \end{aligned} \quad (Eq. 1.2.2-3)$$

where, M_{cre} = Critical elastic lateral torsional buckling moment.

M_y = Yield Moment.

Here equation 1.2.2-2 satisfies the following condition:

$$\begin{aligned} 2.78M_y > M_{cre} > 0.56M_y \\ 2.78 \times 18.82987 \times 10^6 > 13.49819 \times 10^6 > 0.56 \times 18.82987 \times 10^6 \\ 52.347 \times 10^6 > 13.49819 \times 10^6 > 10.544 \times 10^6 \end{aligned}$$

Hence,

$$\begin{aligned} M_{ne} &= \frac{10}{9} M_y \left(1 - \frac{10M_y}{36M_{cre}} \right) \\ M_{ne} &= \frac{10}{9} \times 18.82987 \times 10^6 \left(1 - \frac{10 \times 18.82987 \times 10^6}{36 \times 13.49819 \times 10^6} \right) \\ M_{ne} &= 12.81482 \times 10^6 \text{ Nmm} \end{aligned}$$

Hence Nominal flexural strength for Lateral-torsional buckling is:

$$M_{ne} = 12.81482 \times 10^6 \text{ Nmm}$$

b. Nominal flexural strength for Local buckling as per AISI-S100-07 Section 1.2.2.2 :

The nominal flexural strength, M_{nl} , for local buckling shall be calculated in accordance with the following:

M_{cre} = Critical elastic local buckling moment.

$$\begin{aligned} \text{for } \lambda_\ell \leq 0.776 \\ M_{nl} &= M_{ne} \end{aligned} \quad (Eq. 1.2.2-5)$$

$$\begin{aligned} \text{for } \lambda_\ell > 0.776 \\ M_{nl} &= \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne} \end{aligned} \quad (Eq. 1.2.2-6)$$

$$\text{where } \lambda_\ell = \sqrt{M_{ne}/M_{cr\ell}} \quad (Eq. 1.2.2-7)$$

M_y = Yield Moment.

Here equation 1.2.2-6 satisfies the following condition:

Local-global slenderness ratio λ_ℓ is given as:

$$\lambda_\ell = \sqrt{\frac{M_{ne}}{M_{cr\ell}}} = \sqrt{\frac{12.81482 \times 10^6}{18.56738 \times 10^6}} = 0.83 > 0.776$$

Since $\lambda_\ell > 0.673$, nominal flexural strength, M_{nl} is given by Eq. 1.2.2-6 as follow:

$$M_{nl} = \left(1 - 0.15 \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} \right) \left(\frac{M_{cr\ell}}{M_{ne}} \right)^{0.4} M_{ne}$$

$$= \left(1 - 0.15 \left(\frac{18.56738 \times 10^6}{12.81482 \times 10^6}\right)^{0.4}\right) \left(\frac{18.56738 \times 10^6}{12.81482 \times 10^6}\right)^{0.4} \times 12.81482 \times 10^6$$

Mnl = 12.27769 X 10⁶ Nmm (local-global interaction reduction)

Hence Nominal flexural strength for local buckling is:

$$Mnl = 12.27769 \times 10^6 \text{ Nmm.}$$

c. Nominal flexural strength for Distortional buckling as per AISI-S100-07 Section 1.2.2.3:

The nominal flexural strength, Mnl, for local buckling shall be calculated in accordance with the following:

Mcrd = Critical elastic distortional buckling moment.

for $\lambda_d \leq 0.673$

$$M_{nd} = M_y \tag{Eq. 1.2.2-8}$$

for $\lambda_d > 0.673$

$$M_{nd} = \left[1 - 0.22 \left(\frac{M_{crd}}{M_y}\right)^{0.5}\right] \left(\frac{M_{crd}}{M_y}\right)^{0.5} M_y \tag{Eq. 1.2.2-9}$$

$$\text{where } \lambda_d = \sqrt{M_y / M_{crd}} \tag{Eq. 1.2.2-10}$$

M_y = Yield Moment

Distortional slenderness ratio λ_d :

$$\lambda_d = \sqrt{\frac{M_y}{M_{crd}}} = \sqrt{\frac{18.82987 \times 10^6}{22.44897 \times 10^6}} = 0.92 > 0.673$$

Since $\lambda_d > 0.673$, nominal flexural strength, Mnl is given by Eq. 1.2.2-9 as follow:

$$M_{nd} = \left[1 - 0.22 \left(\frac{M_{crd}}{M_y}\right)^{0.5}\right] \left(\frac{M_{crd}}{M_y}\right)^{0.5} M_y$$

$$M_{nd} = \left[1 - 0.22 \left(\frac{22.44897 \times 10^6}{18.82987 \times 10^6}\right)^{0.5}\right] \left(\frac{22.44897 \times 10^6}{18.82987 \times 10^6}\right)^{0.5} \times 18.82987 \times 10^6$$

$$M_{nd} = 15.62116 \times 10^6 \text{ Nmm.}$$

Hence Nominal flexural strength for distortional buckling is:

$$M_{nd} = 15.62116 \times 10^6 \text{ Nmm}$$

iv. Nominal flexural strength of the beam as per AISI-S100-07 Section 1.2.2:

Nominal flexural strength of the beam is minimum of Mne, Mnl, Mnd.

Hence Mn = 12.27769 X 10⁶ Nmm

$$= 12.27769 \text{ kNm.}$$

For beams meeting geometric and material criteria of section Ω and ϕ shall be as follow:

$$\Omega = 1.67, \quad \phi = 0.9$$

Hence, design strength $\phi Mn = 11.04992 \text{ kNm.}$

Allowable design strength $Mn/\Omega = 7.351911 \text{ kNm.}$

IV. RESULTS

As per IS 801-1975 Flexural strength of beam = 18.8 kNm.

As per Direct Strength Method Flexural strength of beam = 11.04992 kNm.

Experimental value of flexural strength for cold formed steel beam is M = 11.72445 kNm.

V. CONCLUSION

- A comparative study on the flexural strength of lipped channel sections based on different code provisions and the values are compared with respective experimental values. With the comparative study, parametric study has been conducted by varying the lip depth for selected sections through CUFSM analysis, which is the background analysis for DSM.
- The load factor corresponds to distortional buckling for each cross sectional shape has been calculated.
- IS: 801 provisions are not accounting for distortional buckling and hence it over predicts the strength.
- Direct strength method predicts the section strength closer to the experimental results. Load factor corresponds to distortional buckling increases up-to the ratio of lip depth to flange width and later it decreases.

VI. ACKNOWLEDGMENT

I take this great opportunity to acknowledge my deep sense of gratitude towards my guide Prof P.M. Mohite for his valuable guidance without which would have been difficult to present my seminar. I also acknowledge Dr. H.S. Jadhav (HOD Civil Engineering Department) & Prof. D. B. Kulkarni (HOP Civil Structure) for providing the necessary facility to present my seminar. I am very much thankful to all my friends who have helped me to complete my seminar. At last I take this opportunity to thank all those who have directly or indirectly helped me in completion of this seminar work.

REFERENCES

- [1] AISI Stanard, "North American specification for design of steel members", July 2007.
- [2] B.W. Schafer and S. Adany (2006) "Buckling analysis of cold-formed steel members using CUFSM", 18th International Conference on CFS, October 26-27,2006.
- [3] B.W. Schafer "Designing Cold-Formed Steel Using the Direct Strength Method", 18th International Specialty Conference on Cold-Formed Steel Structures October 26-27, 2006.
- [4] Cilmar Basaglia and Dinar Camotim "Buckling, Postbuckling, Strength, and DSM Design of Cold-Formed Steel Continuous Lipped Channel Beams", Journal of structural Engineering. 2013.139: 657,668.
- [5] Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar. Jain, "Design of Steel Structures", Jan 1998,pp 561-600.
- [6] Indian Standard IS: 801-1975, "Code of practice for use of cold-formed light gauge steel structural members in general building construction", Bureau of Indian Standards, New Delhi (1976).
- [7] L. C. M. Vieira, B. W. Schafer, "Behavior and Design of Sheathed Cold-Formed Steel Stud Walls under Compression" J. Struct. Eng. 2013.139:772-786.
- [8] R.B. Kulkarni, Shweta B.Khidrapure, "Parametric study and comparison of Indian standard code with British code for the Design of Light gauge cold formed flexural members", International Journal of Engineering and Technical Research (IJETR) ISSN: 2321-0869, Volume-2, Issue-11, November 2014.
- [9] Somadasa Wanniarachchi, "Flexural behavior and Design of Cold formed steel beams with rectangular hollow flanges", December 2006.Vijayasimhan M , Marimuthu V , Palani G.S and Rama Mohan Rao P (2013) "Comparative Study on Distortional Buckling Strength of Cold-Formed Steel Lipped Channel Sections", Research Journal of Engineering Sciences,Vol 2(4), 10-15 April (2013).

AUTHORS

First Author – Prakash M. Mohite, ME, Rajarambapu Institute of Technology, Islampur, prakash.mohite@ritindia.edu.

Second Author – Aakash C. Karoo, PG Scholar, Department of Civil Engineering, Rajarambapu Institute of Technology, Islampur, akaakashkaroo@gmail.com.

Traditional knowledge of musical instruments used by the Bodo tribes of Northeast India, BTC, Assam.

Jahnovi Brahma*, Tribeni Mandal**, P. Gajurel***, B. Singh*** & P. Rethy***

*Department of Botany, Science college, Kokrajhar;

**Department of English, Science college, Kokrajhar;

***Department of forestry, NERIST, Itanagar

Abstract- *Bodos* have a rich, multi-faceted and distinct culture of their own. The agricultural practices, food habit and belief systems of the *Bodos* reflect a conglomeration of features from both the Aryan and Mongoloid culture. Folk music is a traditional music of unknown authorship, which is transmitted orally generation to generation from the beliefs, and customs of ordinary people of this community. “*Kham*”, “*Siphung*”, “*Serja*”, “*Jotha*”, “*Jabkhring*”, “*Gangona*”, “*Bingi*” and “*Thorkha*” are eight musical instruments used by the *Bodos* of Assam. All these instruments represent various forms of traditional songs accompanied by folk dance. The plants mostly used to make these musical instruments are *Bambusa assamica* Barooah & Borthakur (Poaceae), *Bambusa tulda* Roxb. (Poaceae), *Bambusa pallid* Munro (Poaceae), *Alstonia scholaris* L. (Apocynaceae), *Sterculia villosa* Roxb. (Sterculiaceae), *Sansevieria roxburghiana* Schult.f (Agavaceae) and *Artocarpus heterophyllus* Lam. (Moraceae). Detailed description of the instruments is given below as revealed by the *Bodo* tribes.

Index Terms- Musical instrument, *Bodos*, *Boisagu* and *Kherai*.

I. INTRODUCTION

The *Bodos* or the *Boros* are a race of Mongolian people who are described as the inhabitants of a country lying to the north of the Himalayas and in the Western belt of China. The word ‘Bod’ meaning a Homeland with the inhabitants known as *Bodo phicha* or *Bodosa* (Nath, 1978) includes a large group of people who are linguistically speakers of the Tibeto Burman speeches of the North and East Bengal, Assam and Burma. The word ‘Bodo’ is derived from *Bod*, which means Tibet. Dr. Suniti Kumar Chatterjee, a well-known historian is of the view that they are the offspring of son of the Vishnu and Mother-Earth who were termed as ‘*Kiratas*’ during the Epic period that came to Assam in 2000 B.C. Traditionally this group of community is endowed with rich cultural heritage, diverse food habits, mythological faiths and socio-magico rituals. The festivals of the *Bodos* are closely related to music and dance. They perform music and dance in almost all the festivals for they are inseparable components of their rites. Thus, the musical instruments of these tribes play a very crucial role in shaping the cultural diversity of *Bodos*. Seasonal festivals like *Domashi*, *Boisagu*, *Kangali bihu* and other religious festivals like *Kherai* and the *Garja puja* are celebrated with pomp and show by using these traditional musical instruments (K Brahma,

1998). All these musical instruments are available in the society and are very uncommon in size and structure in comparison to the other Aryan musical instruments. There are lots of myths relating the origin of the various musical instruments of *Bodos*. The mythical tales relating to different musical instruments of the *Bodos* does not describe in detail how the musical instruments did originate, but contains clue as to how the instruments were first used by the *Bodos* in different festivals and ceremonies. All these instruments are made of bamboo or wooden materials and some of them were made of brass metal also. A good number of ethnobotanical works have been done on *Bodo* tribes of northeastern region including Brahma (1960), Narzi (1964), Baruah (1969), Boro (2001, 2004).

II. METHODOLOGY

Field survey and interview of inhabitants associated with cultural organization were conducted in various *Bodo* villages. Those inhabitants that were primarily attached with cultural programmes having knowledge of indigenous musical instruments were consulted and information based on plants used in making these instruments was recorded. Voucher specimens of plants were collected and documented. The plant specimens were identified and herbarium was deposited for authenticity at the Department of Forestry, NERIST, Itanagar.

III. DISCUSSION

A traditional music of unknown authorship, which is transmitted orally, is what one calls folk music. The origin of it is the beliefs and customs of ordinary people of a community. The *Bodo* community as such is very rich in folk culture and is enriched with the traditional folk music of the community. There are some musical instruments of these people, which represent all forms of the traditional songs of the community.

Various plants used in making these traditional musical instruments by the *Bodos* are –

“*Siphung*”: It is a long flute made from a particular bamboo called *Owajlaw* (*Bambusa pallida*) and *Owathare* (*Bambusa assamica*). It is 27-29 inches long with five holes for playing and one hole for blowing. It is played on occasions such as *Kherai puja*, *Garja puja*, *Boisagu* festival, *Domashi* festival and in marriage ceremony. It is ceremonially played on the first day of the *Boisagu* festival with the belief that

“*Serja*”: It is a harp like instrument having three strings made of *Alstonia scholaris* and *Artocarpus heterophyllus* wood.

The lower part of the body is hollow and a part of it is covered with the skin of goat or Maphou (*Iguana*) skin. It has four strings made of muga silk or barks of *Sterculia vilosa*. Its accessories consist of four puthis or tuning knobs, one ghora or bridge, one bow made of bamboo with its string made of horse tail hair or Odal (*Sterculia villosa*) bark or fibres obtained from *Sansevieria roxburghiana* leaves. This instrument is used in marriage ceremony, *Boisagu* and *Domashi* festivals.

“Bingi”: - It is a single one stringed blowing instrument. It has a wooden frame body made of bamboo (*Bambusa tulda*) with coconut shell attached at the bottom. The whole wooden or bamboo part called the trunk of the instrument is long at the beginning from the apex down to the coconut shell. The coconut shell is horizontally divided and the best portion which is little bigger than the half is taken for connecting it to the base. The whole face of the shell is covered by the leather of goat in such a manner that the trunk pierces out the shell. There is a small bridge on the leather below the string made of Muga threads wrapped each other firmly giving rise to a single thread like structure. The bridge is applied to make the string correct and comfortable during playing. The play is carried out by a bow made of bamboo piece.

“Thorkha”:- It is made from *Bambusa tulda*. Also called as bamboo clapper, it is made by splitting a piece of bamboo lengthwise in the middle and played by holding with both hands. Its size varies from 2-1/2 feet to 3 feet in length and it is largely used by the Bodo women during *Boisagu* and *Domashi* celebrations.

“Kham”: It is a big drum about 3^{1/2} to 4 inches in length and about 2^{1/2} to 3 inches in diameter. It is made from the trunk of *Alstonia scholaris*, *Artocarpus heterophyllus*, *Magnifera indica* or *Sterculia villosa*. The two sides of the wooden frame are covered with deer skin or goat skin while the braces are made of buffalo skin. This instrument is played on ceremonial occasions like *Kherai puja* and *Garja puja*.

“Jotha” (Cymbal):- The *zotha* is called cymbal in English. It is basin like musical instrument beaten together in pairs. It is equal in size and shape with those used by the musicians of authentic Indian music and is procured from the market. It is used to keep time with the music played on the occasions of *Kherai puja*, *Garja puja*, *Boisagu* and *Domashi* festivals.

“Jab-khring”:- It has an wooden frame on which are fitted small round pieces of metal sheet. When two wooden frame are struck on one another, the wood and the metal pieces produce a clapping and jingling sound. It is basically made from the woods of *Alstonia scholaris* or *Artocarpus heterophyllus* and is basically used in marriage ceremony, in *Boisagu* and *Domashi* festivals.

“Gongona”:- *Gongana* also called the Jew’s harp is a kind of wind instruments use by the Boros. It is made of bamboo (*Bambusa assamica*). It is flat having only one internodes, which varies from 6" to 7" in length, while 1/2" to 3/4" in breath. The wider end has a ridge hook in the interior side to catch the same in between the lips in a balanced state. The opposite end is somehow tapering which is tightened by a very firm thread. It is

mostly played by the women and girls in the *Boisagu* and *Domasi* festivals.

IV. CONCLUSION

The Bodo tribes are conservative and reluctant to share their traditional knowledge. Ceremonies, traditions and rites are practiced with religious beliefs, which also involve worship of spirits, spirit beings and forces. It is the music that helps the people maintain a much cherished separate identity forming a link to the past and an assurance that the future will still incorporate a unique identity. The valuable and vast traditional knowledge of this community of the North-East India need to be documented, preserved, revitalized and spread throughout for the benefit of the human beings.

ACKNOWLEDGEMENT

The authors are thankful to the Head, Department of Forestry, NERIST, Itanagar for various facilities and constant encouragement. The authors are also grateful to all the villagers, cultural members of Kokrajhar Cultural Association, ABSU and other organizations for providing relevant information on this topic as required.

REFERENCES

- [1] Baruah, B. K. 1969. A cultural history of Assam, Vol. 1, Gauhati. Pp. 223
- [2] Boro, A. 2001. Folk literature of the Bodos: An Introduction. Adhunik Prakashan, Guwahati. Pp. 326
- [3] Boro, A. 2004. The Flute and the Harp: Essays on Bodo Literature and Culture. Guwahati: GBD publishers.
- [4] Brahma, M. M. 1960. Folk Songs of the Bodos, Gauhati University.
- [5] Brahma, K. 1994. A Study of Socio- Religious Beliefs, practices and ceremonies of the Bodos. Kunthi Pusthak, Kolkata. Pp. 159.
- [6] Narzi, B. 1964. Boro Kacharir Samaj Aru Sankriti. Bina Library, Gauhati. Pp. 67
- [7] Nath, R. M. 1978. The Background of Assamese Culture. Dutta Barua and Co., Gauhati. Pp. 56

AUTHORS

First Author – Jahnovi Brahma, Department of Botany, Science college, Kokrajhar, Phone no. - 9706075655

Email Id: jahnovibrahma6@gmail.com

Second Author – Tribeni Mandal, Department of English, Science college, Kokrajhar

Third Author – P. Gajurel, Department of forestry, NERIST, Itanagar

Fourth Author – B. Singh, Department of forestry, NERIST, Itanagar

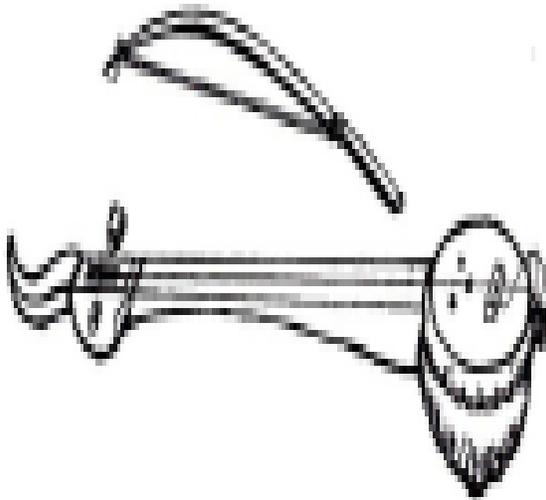
Fifth Author – P. Rethy, Department of forestry, NERIST, Itanagar



i) Sifung



ii) Serja



iii) Kham



iv) Thorkha



v) *Jotha*



vi) *Jabkhring*



vii) *Gongona*

A Comparative Study of Cardiovascular Parameters in Obese and Non-Obese Individuals

Dr.Ravikeerthy.M, Dr.Tejaswi Nataraj

MBBS, MD(Gen Med)

Abstract- Obesity by definition is a state of excess adipose tissue mass. Obesity is a global epidemic becoming a threat to healthy populations in increasing number of countries. . Numerous studies have documented that obesity and, more particularly, central adiposity as indicated by an enlarged waist circumference (WC), is associated with the presence of systemic hypertension, coronary heart disease, type 2 diabetes mellitus as well as an increased mortality risk. The cardiovascular disorders due to obesity result in increased mortality from complications such as coronary artery disease, heart failure, arrhythmias and sudden death(8). This study was done to study the importance of cardiac parameters in obesity which is a preventable condition which in turn reduces the morbidity and mortality.

Objectives: Objectives: To analyze the parameters like Systolic blood pressure , diastolic blood pressure ,mean arterial pressure, heart rate and pulse pressure in obese and non-obese population.

Materials and methods: 75 male obese and non-obese patients were randomly selected for the study from the outpatient department. Careful measures were taken to avoid people with age less than 20years and more than 50years, female sex, smoking, existing cardiovascular disease and respiratory diseases. **Results:** Mean age of obese subjects was 31.52+/-6.38 and non-obese subjects was 31.41+/-6.20. BMI in obese and non-obese subjects was 32.26+/-1.39 and 22.76+/-0.730 respectively which is statistically significant($p < 0.001$). They also had statistically significant difference in terms of weight(83.72+/-5.17 in obese subjects and 61.12+/-3.73kgs in non obese subjects, $P < 0.001$) and Body surface area(BSA) (1.94+/-0.0777 in obese and 1.68+/-0.0682 in non obese subjects). The study showed that the obese subjects had significantly high systolic(140.32+/-6.93 vs 121.59+/-6.67mmhg) and diastolic blood pressure(86.11+/-6.79). **Conclusion:** The study shows that obese individuals had significantly more blood pressure(both systolic and diastolic) and increased heart rate compared to non-obese individuals.

Index Terms- obesity. systolic, diastolic, blood pressure, mean arterial pressure, heart rate

I. INTRODUCTION

Obesity by definition is a state of excess adipose tissue mass. Although it is often viewed as a equivalent to increased body weight, which maybe not true always. Lean but very muscular individuals may be overweight by numerical standards without increased adipose tissue(1) Obesity is a global epidemic becoming a threat to healthy populations in increasing number of countries.(2). The prevalence of obesity has increased recently in

younger population. Numerous studies have documented that obesity and, more particularly, central adiposity as indicated by an enlarged waist circumference (WC), is associated with the presence of systemic hypertension, coronary heart disease, type 2 diabetes mellitus as well as an increased mortality risk.

Most widely used method to measure obesity is Body-mass Index(BMI). Other approaches are Anthropometry(skin fold thickness), Densitometry(underwater weighing), CT scan/MRI scan and electrical impedance. A BMI of 19-24.99 are considered normal, 25 -30 are considered overweight and >30 are considered as Obese. Data from the National health and Nutrition examination survey(NHANES) shows that the percentage of American adult population with obesity has increased from 14.5% to 33.9. As many as 68% of US population above the age of 20 are were overweight(1)

Obesity is a global epidemic becoming a threat to healthy populations in increasing number of countries.(2). Obesity has been reported to be associated with a number of cardiovascular (CV) diseases, pro-inflammatory state, coagulation abnormalities and metabolic disturbances such as lipid abnormalities, altered glucose metabolism, insulin resistance and type 2 diabetes mellitus (3). Studies have shown that the obese patients are more prone to ventricular arrhythmia and obesity is a strong predictor of sudden death in men.(4). Decreased HRV has been shown to significantly increase CVD risk and it has been considered as a strong mortality predictor (5). Numerous studies have documented that obesity and, more particularly, central adiposity as indicated by an enlarged waist circumference (WC), is associated with the presence of systemic hypertension, coronary heart disease, type 2 diabetes mellitus as well as an increased mortality risk. A variety of adaptations in cardiorespiratory structure and function occur in the individual as adipose tissue accumulates in excess amounts, even in the absence of comorbidities. Hence, obesity may affect the heart and lungs through its influence on known risk factors such as dyslipidemia, hypertension, glucose intolerance, inflammatory markers, obstructive sleep apnea, hypoventilation, and the prothrombotic state, in addition to as yet unrecognized mechanisms(6). Heart rate variability (HRV) analyses represent a noninvasive technique for assessing the heart autonomic nervous system function in a variety of clinical conditions such as diabetic neuropathy , obesity , myocardial infarction , sudden death and congestive heart failure . Reduced HRV has been shown to predict increased mortality in the general population as well as in patients with cardiovascular disease (CVD)(5) . Along with the epidemic of obesity and abdominal obesity, concomitant metabolic derangements pose obese individuals at greater risk for future morbidity and mortality (7) The exact mechanism of increased cardiovascular mortality in obese individuals has not

been clearly specified yet but reduced HRV may be one of the potential pathways involved in sudden death. Indeed, cardiovascular autonomic dysfunction has been associated with obesity in humans and animals.(5).

The cardiovascular disorders due to obesity result in increased mortality from complications such as coronary artery disease, heart failure, arrhythmias and sudden death(8). This study was done to study the importance of cardiac parameters in obesity which is a preventable condition which inturn reduces the morbidity and mortality.

II. OBJECTIVES

To analyze the parameters like Systolic blood pressure , diastolic blood pressure ,mean arterial pressure, heart rate and pulse pressure in obese and non-obese population.

III. MATERIALS AND METHODS

75 male obese and non-obese patients were randomly selected for the study from the outpatient department. Careful measures were taken to avoid people with age less than 20years and more than 50years, female sex, smoking, existing cardiovascular disease and respiratory diseases. Obese people are those with BMI >30 and non obese were had BMI between 18-24.99. People with BMI of 25 to 30 were also excluded from the study. After taking the detailed history, clinical examination .Subjects were allowed to take rest for 10 minutes in bed before the examination. BMI was calculated using the Quetelex index= weight in kgs/height(m²), Blood pressure was recorded using a spymomonometer and heart rate was calculated with 12 lead

ECG. Mean arterial pressure was calculated using the MAP calculator and pulse pressure was derived from the standard protocol by deducting diastolic pressure from systolic blood pressure.

IV. STATISTICAL ANALYSIS

Was done using chi square test and pearson’s coefficient was measured to compare both groups , results were mentioned in mean with SD.

V. RESULTS

Of the 75 subjects in each group, there were 32 subjects in obese group and 31 subjects in non obese group in the age group of 21-30 years,34 subjects in both groups in 31-40 years age group and 9 subjects in obese and 10 subjects in non obese in age group 41-50(table1).

Mean age of obese subjects was 31.52+/-6.38 and non-obese subjects was 31.41+/-6.20. BMI in obese and non-obese subjects was 32.26+/-1.39 and 22.76+/-0.730 respectively which is statistically significant(p<0.001).They also had statistically significant difference in terms of weight(83.72+/-5.17 in obese subjects and 61.12+/-3.73kgs in non obese subjects, P<0.001) and Body surface area(BSA) (1.94+/-0.0777 in obese and 1.68+/-0.0682 in non- obese subjects).The study showed that the obese subjects had significantly high systolic(140.32+/-6.93 vs 121.59+/-6.67mmhg) and diastolic blood pressure(86.11+/-6.79).

Table 01: Distribution according age & Obesity in the study subjects

Age	Obesity (%)	Non Obesity (%)	Total
20 - 30	32(50.79)	31(49.21)	63
30 - 40	34 (50.0)	34(50.0)	68
40 - 50	09(47.37)	10 (52.63)	19
Total	75	75	150

Chi square value 0.069; d.f – 02, with P Value is 0.9663

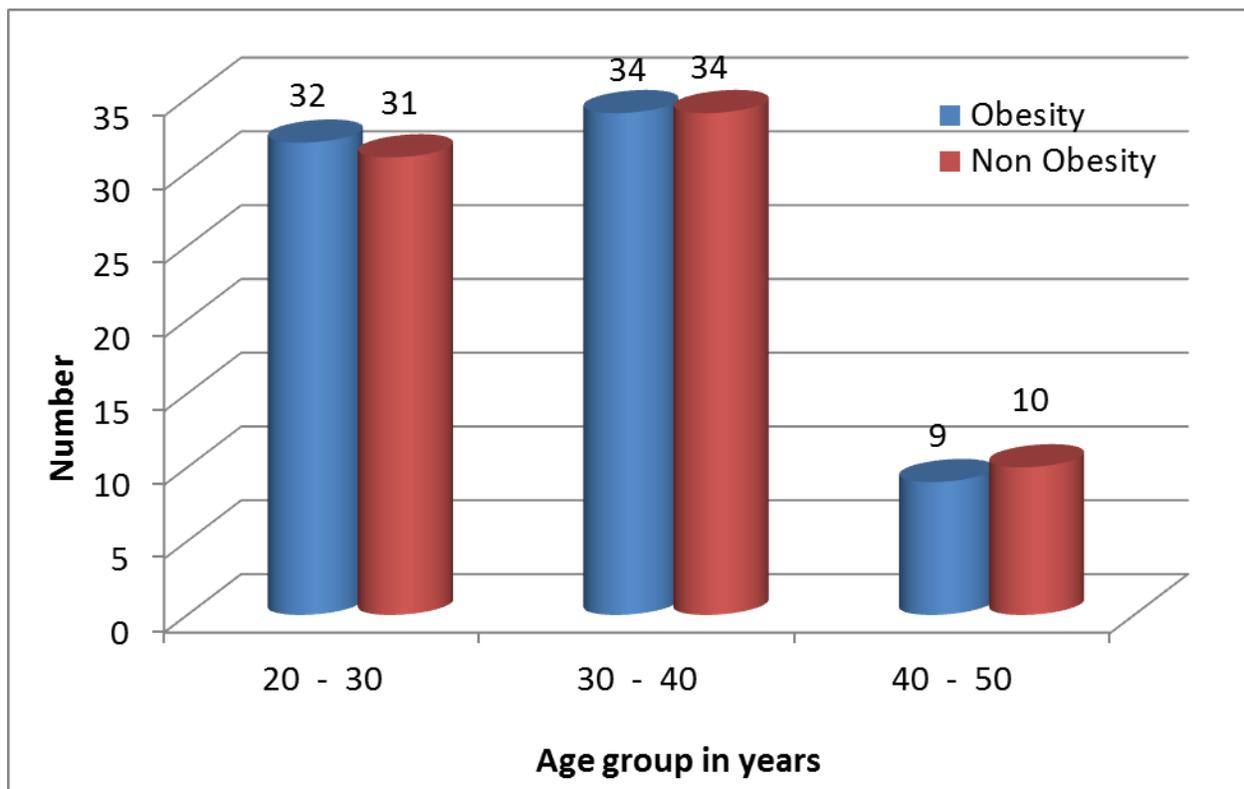
Graph 01: Multiple bar diagram showing distribution according to age group and Obesity status

Table 02 : Mean & Standard deviation among obesity & Non- obesity for all the parameters

	Obesity	Non Obesity	T- test Value (P- Value)
Age	31.52 ± 6.38	31.41 ± 6.20	0.01(0.917) NS
Height	161.85 ± 3.75	164.49 ± 3.16	21.68(0.0000710) S
Weight	83.77 ± 5.17	61.12 ± 3.73	947.14(<0.001) S
BMI	32.26 ± 1.39	22.76 ± 0.730	2745.50(<0.001) S

BSA	1.94 ± 0.0777	1.68 ± 0.0682	476.12(<0.001) S
HR	85.87 ± 3.70	70.67 ± 4.62	494.83 (<0.001) S
SBP	140.32 ± 6.93	121.59 ± 6.67	284.65(<0.001) S
DBP	86.11 ± 6.79	75.87 ± 4.56	117.67(<0.001) S
MAP	104.22 ± 6.16	91.12 ± 5.03	203.35(<0.001) S
PP	53.15 ± 6.54	45.72 ± 4.32	67.39(<0.001) S

Graph 01: Multiple bar diagram showing distribution according to age group and Obesity status



VI. DISCUSSION

Adipose Tissue is not a passive storehouse of fat and has a resting blood flow of 2-3 ml/min/100gm of fat. It is an endocrine and paracrine organ that produces various hormones that are involved in regulating cardiovascular hemodynamics. The increased metabolic demand created by the excess adipose tissue will increase total blood volume and cardiac output to keep up with the demand. This increases the workload on the heart causing cardiac hypertrophy as well as increasing sympathetic activity. This in turn explains the statistically significant increase

in the systolic BP, Diastolic BP, heart rate, pulse pressure and mean arterial pressure which has been observed in our study.

Tuck ML et al have showed in their study that the obese individuals have increased heart rate secondary to increased sympathetic activity and increased rennin-angiotensin-aldosterone system activity(9). In a similar study done by Ravishankar et al have showed that there is significant increase in systolic ,diastolic blood pressures in obese individuals compared to non obese individuals(10).

VII. CONCLUSION

Our study provides a glimpse to some of the cardiovascular alterations that happen as adipose tissue accumulates. These alterations reflect the body's adjustments to cope for the increased workload. The structural/ anatomical alterations secondary to this- for example cardiac hypertrophy and other microscopic/molecular changes does contribute to forming risk factors for cardiovascular disease in the long run. As we can see from many studies obesity is major risk factor cardiovascular disease and diabetes which in turn are responsible for morbidity and mortality. As obesity is a preventable condition, early steps to prevent obesity will reduce the major morbidity and mortality.

REFERENCES

- [1] Jeffrey S. Flier and Eleftheria Maratos Flier: Harrison' principles of internal medicine(18th edition):chapter 77 Volume 1: Biology of Obesity:622-629
- [2] Rabia Siddiqui, Noorunnisa, Muhammad Abdul Azeem, Nudrat Khan, Muhammad Younus Jamal Siddiqui: Pak J physiol:2013;9(1):20-25
- [3] Indumathy J, Pal GK*, Pravati Pal, P.H. Ananthanarayanan, S.C. Parija, J. Balachander, T.K. Dutta :Obesity research and clinical practice:2014;orcp 368:e1-e12
- [4] Kristjan Karason, Henning Mølgaard, John Wikstrand, and Lars Sjöström: Am journal of cardio:83:19991242-1247
- [5] Natalia Poliakova , Jean-Pierre Després , Jean Bergeron , Natalie Alméras, Angelo Tremblay, and Paul Poirier: METABOLISM CLINICAL AND EXPERIMENTAL 61 (2 0 1 2) 1 2 7 0 – 1 2 7 9
- [6] Kanavi Roopa Shekharappa , Smilee Johny S , Mallikarjuna P T , Vedavathi K J , Mary Prem Jayarajan: Int J Biol Med Res. 2011; 2(2): 551-555
- [7] Sorena Keihani , Farhad Hosseinpanah, Maryam Barzin, Sara Serahati, Soraya Doustmohamadian, Fereidoun Azizi: Atherosclerosis 238 (2015) 256e263
- [8] Clinical Guidelines on the identification, Evaluation, and Treatment of Overweight and Obesity in adults: The evidence report : National Institutes of Health. Obes Res. 1998; suppl 2:51S-209S
- [9] Tuck ML, Sowers J, Dornfeld L, Kledzik G, Maxwell M. The effect of weight reduction on blood pressure, plasma rennin activity, and plasma aldosterone levels in obese patients. N Engl J Med. 1981; 304:930-933.
- [10] Ravisankar P, Mohan M, Udupa K, Sankarnarayana EP. Correlation between BMI and blood pressure indices, handgrip strength and handgrip endurance in under weight, normal weight and over weight adolescents. Indian J Physiol Pharmacol. 2005;49(4):455-461.

AUTHORS

First Author – Dr. Ravikeerthy.M, MBBS, MD(Gen Med), E-mail: ravikeerthym@gmail.com, Ph: 09845295227

Second Author – Dr. Tejaswi Nataraj, MBBS, MD(Gen Med), E-mail: tejnat@gmail.com , Phone: 09964592714

Correspondence Author – Dr. Ravikeerthy.M, No.20, MAXCURE SPECIALITY CLINIC, BEHIND KARIAPPA PARK, NEAR POLICE STATION, UNIVERSITY LAYOUT, RAJARAJESWARINAGAR, BANGALORE-560098, Ph: 09845295227

The Role of Strategic Sourcing on Organization's Performance: A Case Study of Jomo Kenyatta University of Agriculture and Technology

Titus Wachira Kihanya^{*}, Moses Kimani Wafula^{**}, Evans Ojiambo Onditi^{***}, Ambrose Muriithi Munene^{****}

^{*} Assistant procurement officer, Jomo Kenyatta University of Agriculture and Technology, P.O Box 81310-80100, Mombasa

^{**} Senior Assistant Librarian, Jomo Kenyatta University of Agriculture and Technology, P.O Box 81310-80100, Mombasa

^{***} Lecturer Jaffery Institute of Professional Studies, P.O Box 82522-80100, Mombasa

^{****} Kenyatta University Mombasa Campus, P.O. Box 16778-80100, Mombasa

Abstract- Strategic sourcing is growing at a rapid rate throughout the world because organizations view it as a way to achieve strategic goals, improve customer satisfaction and provide efficiency and effectiveness services. This study was guided by the following objectives: to determine the role of quality of goods and services on organization's performance; to establish the role of cost of goods and service; to establish the role of supplier relationship; the role of timely delivery of goods and services and to determine the role of effective procurement plans on organizational performance. Descriptive research design was used in conducting this study. The target population for the study were the employees of Jomo Kenyatta University of Agriculture and Technology, Main Campus. A sample size of 89 employees, with stratum of top level management, middle level management, first line management and low level management was selected from the various departments. Questionnaires were used to collect data. Data was analyzed using SPSS. To test the validity of the research instruments, the researcher sought expert's opinion and reliability was done to a few employees who were not included in the final study. The study findings were interpreted and discussed. The findings were presented using frequency distribution tables and charts to clearly show the response from the respondents.

The findings of this study suggested that strategic sourcing enables the organization to achieve strategic advantage and at the same time act as a means in which a business condition or problem can be alleviated in a more efficient and effective manner.

Although strategic sourcing is essential to the university, the respondents indicated that quality of goods and services was the most highly rated variable followed by cost of goods and services, timely delivery of supplies, effective procurement plan and lastly supplier relationship in that order. The performance of strategic sourcing was indicated as being affected by poor planning, failure to adhere to procurement plans and inadequate funding.

It was concluded that quality goods and services plays a very major role in determining the organization performance due to its high rating by the respondents. It was also concluded that the cost of goods and services affects its competitiveness. The study finally recommended that the university should maximize on its human capital as its most priced asset, should have a formal strategic sourcing, it should also put all measures in place

to ensure that they do not face severe losses as a result of poor supplier relationship and finally the management should ensure that respective departments should prepare well planned budget and operate within the budget and funds allocated.

Index Terms- Strategic sourcing, Supplier relationship

I. INTRODUCTION

Sourcing has evolved from a traditional purchasing approach which was transactional and opportunistic in nature where organizations used to buy in response to immediate needs, choosing freely from among all the suppliers that can supposedly meet those needs to one that is futuristic and uses plans and strategies. Traditional sourcing was sporadic and transactional and treated each purchase as a discrete transaction. Communication typically entailed haggling over prices, complaining about late shipments or disputing the quality of products.

As a result, traditional sourcing method has had its celebrated failures. Regular reports have been published about cost overruns, contract disputes and poor customer satisfaction. Many of these failures have been due to inflexibility of the sourcing contract, which cannot easily be changed to respond to market pressures and business requirements (Predrag, 2008).

Lysons and Farrington (2006), defines strategic sourcing as "concerned with the top-level, longer-term decision relating to high – profit, high supply risk items and low-profit, high supply risk bottleneck product and services". It's also concerned with the formulation of long-term purchasing policies, supplier base, partnership sourcing, reciprocal and intra- company trading, globalization and countertrade, the purchase of capital equipment and ethical issues. Sourcing costs represent 40 to 80 percent of the cost of goods sold, and 30 to 50 percent of revenues – a ratio that has remained constant in most industries for many years. Companies excelling in strategic sourcing save almost 10 to 20 times as much as it costs to operate their sourcing operations. The effort required to reduce 10 percent of the sourcing cost is much less than gaining similar amount of revenue (Chopra and Meindl, 2003).

In Kenya, the PPDA (2005) stipulates the guidelines on how public entities should source their supplies. The Act establishes

the procedures for efficient public procurement and disposal of unserviceable, obsolete or surplus stores, assets and equipment by public entities. It also provides for the other related matters including integrity, fairness, transparency, efficiency and increasing the public procurement process. The Act also establishes the Public Procurement Oversight Authority (PPOA) which is an independent body to oversee and regulate procurement in the public sector. This body ensures that the procurement procedures established under the Act are complied with, monitor the procurement system, initiate public procurement policy and propose amendments to this Act and to perform such other functions and duties as provided for under this Act. Given the size of public procurement, the Kenyan government decided to initiate reforms through policy, legal and institutional frameworks to enhance transparency, accountability, fairness and competition in the procurement process (PPOA, 2005, Edward, 2011)

PPDA (2005) lays down the guidelines which guides public entities in sourcing their supplies. The Act define procurement as acquisition by purchase, rental, lease, hire, license, tenancy, franchise or by any other means any type of work, assets, services or goods including livestock or any combination. It also establishes procedures for the efficient public procurement and disposal of unserviceable, obsolete or surplus stores, assets and equipment.

PPDA (2005), also sets thresholds which guide the procurement methods in public entities i.e. when to use international open tenders, national open tender, restricted tenders, request for proposal, direct procurement or request for quotation. The Act treats every purchase as a discrete transaction subjected to competitive bidding and therefore it fails to address other benefits that could be accrued if public entities categorize their spending and involve suppliers from early stages of purchase. Government procurement is long and bureaucratic. In Order for JKUAT to be and remain competitive, it needs to exercise sourcing practices that will make it compete competitively with private institution who have less bureaucratic procurement process for the quality supplies at the right quantity, at the right price, time and delivered at the right place. Sourcing strategically can be crucial for JKUAT to obtain or sustain its competitiveness in the marketplace.

General objective

The general objective of this research was to establish the role of strategic sourcing in the performance of an organization.

II. LITERATURE REVIEW

Related work

Institutional theory

This theory explains how an organization's environment through regulative, normative and cognitive mechanisms institutionalizes and legitimizes strategies (Scott, 1995). Although institutional theory and "neo-institutional" theory (e.g. March and Olsen, 1984) differ on whether organizational adaptation is the result of conscious decision processes made to conform to the organization's environment (the latter ascribes more importance to such decisions), both predict that institutional pressures may cause the organization to adopt sourcing strategies that conform to its environment. Varying

institutional pressures may cause organizations to source in different ways which may have economic consequences and may lead to ethical dilemmas. Nonetheless, it is important for firms to be within the range of legitimate sourcing strategies because a legitimate firm obtains resources of higher quality at more favorable terms than an illegitimate firm. On the other hand, if firms are too similar strategically, performance may suffer. Thus, it would appear that firms should select sourcing strategies that help legitimate them, but do not lead to isomorphism. Monitoring changes in government policies and regulations (e.g. changes in changes in free trade agreements among countries, or changes in tax regulations, or legislation supporting minority- and women-owned businesses) as they relate to sourcing decisions may allow a firm to be an early adopter of sourcing innovations. However, outsourcing may have serious negative short- and long-term consequences such as increased costs and decreased performance and the loss of critical skills and knowledge, hence, managers should be careful to make sourcing decisions based on their strategic merit. (Gimeno and Woo, 1996 Deephouse, 1999, Scott, 1995, DiMaggio and Powell, 1983, Rosetti and Choi, 2005, Jennings, 2002)

Agency theory

From the perspective of agency theory, a firm outsourcing a function is the principal, and the supplier is the agent. Agency theory maintains that the make versus buy decision should be determined by the economic relationship between production and transaction costs. If production costs are lower than transaction costs, firms should produce and manage the process internally and vice versa. Transaction costs include the actual outsourcing costs as well as additional monitoring and control costs assumed by the principal. Monitoring costs are any costs incurred by the principal to ensure that the agent is not engaging in activities detrimental to the principal, as well as ensuring the principal is meeting the basic terms and conditions of the outsourcing contract. Control costs represent the legal costs assumed by the principal to enforce the terms of the outsourcing contract upon term violation. (Eisenhardt, 1989; Jensen and Meckling, 1976).

Agency theory tenets imply that lower transaction costs are driving firms away from sourcing internally and toward purchasing or alliance outsourcing relationships. Several primary forces are cited as driving the movement towards more frequent and stronger sourcing relationships between principals and agents. In addition, the increased use of outsourcing as a strategic tool has given many firms increased experience in designing effective monitoring and control systems to manage agent behaviors. Given the increased information available to sourcing principals, increased number of agents and heightened competition among agents, agents assume higher risks for engaging in opportunistic behaviors against principals. . (Logan, 2000, Zsidisin et...al, 2004)

Network theory

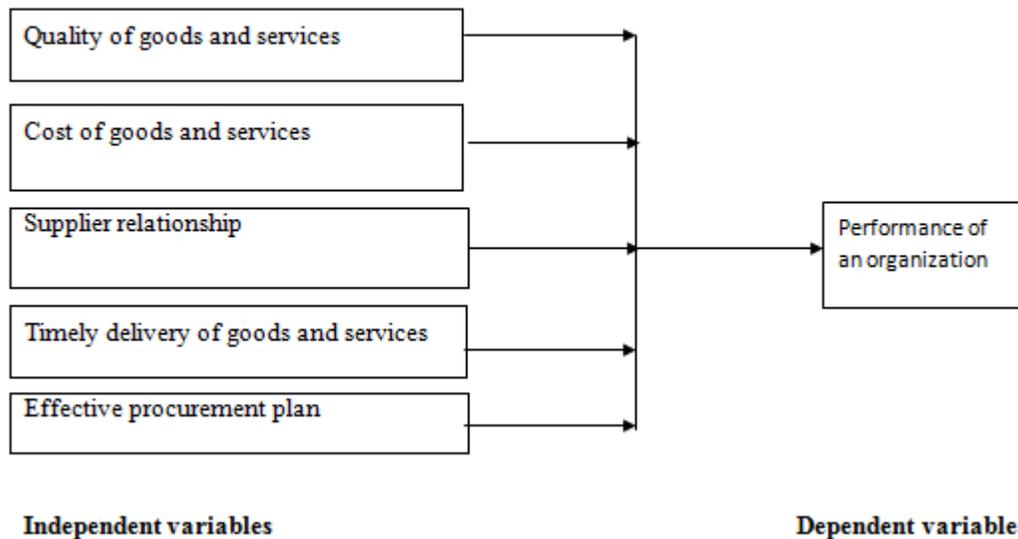
Network theory centers on the relationships a firm has with other firms and on how these relationships influence a firm's behavior and outcomes. Network theory does not seem to inform the choice of when to make, buy or ally. It does however, appear to inform choice of which firms an organization chooses to buy from or engage with as alliance partners. Centrality refers to how

pivotal a firm is within a network. High centrality refers to a firm that is always sought out as a partner. Being central within a network offers four key competitive priorities within supply chains: speed, quality, cost, and flexibility. A highly central firm can tap its tight links in order to rush orders when needed, seek out the provider offering the best materials and lowest prices and

make seamless transitions over time. Thus, with regard to sourcing, a firm should strive to be central to its network and should seek sources that are central to their networks. (Gulati et...al, 2000, Thorelli, 1986, Hult et...al, 2006)

Conceptual Framework

Figure 2.1 Conceptual framework



Quality of goods and services

Baily, P.et...al.(2005) quality circles have become a popular approach to the improvement not only of product quality but also of other aspect of company performance and the quality of working life. ISO (1995) as cited in Lysons (2006), defines quality as the totality of features and characteristics of product that bears on the ability to satisfy stated or implied need whereas Crosby (1980, cited in Lysons, 2006, P 266) defines quality as “conformity to requirements not goodness. Quality is very important for ensuring good performance and success of any organization..Quality control contributes to profitability and growth. Quality of goods and services determines the performance of an organization through increased sales, customer retention and business sustainability (Barker, 2006)

Organizations products evolve over time and it is critical to form relationships with suppliers that can effectively meet the changing requirements from the perspective of new product development, design, manufacturing processes and manufacturing capability, at lower costs. Such suppliers are more likely in the long run to have the infrastructure and organizational capabilities in place to effectively meet the changing demands of the buying firms. Quality management practices with strategic implications such as total quality management, zero defects, process improvement, statistical process control, and continuous process improvement lead to tangible improvements in quality and cost reduction

(Barker, 2006 De Ron,1998 ,Lederer and Rhee, 1995,Tham, 1988 ,Koulamas, 1992, Tummalaset...al, 1997, Coughlan and Wood, 1992, The Economist 2006, Global Investor 2005).

Cost of goods and service

Strategic sourcing differs in its focus and execution from traditional purchasing and offers several obvious benefits. Traditional purchasing focuses on purchase price, whereas strategic sourcing focuses on the true cost to the customer. Strategic sourcing benefits both buyers and suppliers. It benefits buyers because they can negotiate lower unit prices for high-volume purchases, thus reducing cost of goods sold and maintaining the ability to price their products competitively. It benefits suppliers because they are able to sell a significant portion of their output, which makes planning easier and gives management long-term cash flow visibility.

Strategic sourcing has been proven to be affective and result in cost reduction, increases in productivity, quality improvement, and return on investment. Considering sourcing as strategic has been considered as a driver for company growth. Strategic sourcing allows an organization to shares information with its suppliers in real time with the aim of cutting the cost of materials, minimizing inventory, reducing shortages, and expediting deliveries. Strategic sourcing can reduce costs by consolidating purchases with a limited number of suppliers and by allowing the centralized purchasing departments negotiating leverage via a purchase of increased volume. Strategic sourcing can also help reduce ordering costs of purchasing orders thus reducing inventory handling costs (Rendon, 2005, and Van Weele, 2010, Thomas, 1999)

Supplier Relationships

Competitive forces are putting firms under pressure to improve quality, delivery performance, and responsiveness while simultaneously reducing costs. In response, firms are increasingly exploring ways to leverage their supply chains and in particular, to systematically evaluate the role of suppliers in their activities. One result has been the increased outsourcing of activities not considered to represent core competencies. This has enabled firms to better utilize their resources and increase the value added attributable to them. It also allows them to be more flexible and responsive to changing needs. Outsourcing allows firms to exploit the capabilities, expertise, technologies, and efficiencies of their suppliers. Increased outsourcing, however, implies greater reliance on suppliers and a commensurate need to manage the supplier base. This has for some companies meant reducing and streamlining the supplier base, and/or developing closer relationships with suppliers. It is critical for companies to have good relationships with strategic suppliers and that the strategic suppliers are aware of the implicit or explicit criteria by which buyers evaluate relationships. Strong relationships with supplier can provide great benefits for buyer and supplier. The direct, significant and positive relationship between strategic sourcing and buyer-supplier relationship empirically validates the assertions made by [Carr and Pearson \(1999\)](#) that strategic purchasing positively impacts buyer-supplier relationships. ([Pralhad and Hamel, 1990](#) , [Scannell et... al, 2000](#) , Pressey et...al, 2007, Sánchez - Rodríguez, 2009, Thomas, 1999, Carr and Pearson, 1999, [Modi and Mabert 2007](#), [Chan and Chin \(2007\)](#)).

Strategic sourcing can be adopted to evaluate suppliers, especially company's capabilities and quality management. Companies need to develop a functional partnership with strategic supplier and buyer-supplier relationships can be a base of competitive advantage if companies combine resources in unique ways. Strategic sourcing includes a wide range of activities namely creating an overall strategy for sourcing, evaluating and selecting suppliers, procuring materials/services and managing supplier relationships. Sourcing if properly structured can effectively combine the core competencies of a given firm with the skills and capabilities of its suppliers. Sourcing decisions are vital for any organizations that want to leverage on its core competencies and outsource other activities in order to gain and retain competitiveness (Sánchez-Rodríguez, 2009, Chiang et...al, 2012, Pressey et...al, 2007, Predrag, 2008, [Anderson and Katz, 1998](#)).

Timely delivery of goods or service

According to Baily, et...al, (2005), if a company is seeking competitive advantage by becoming better able to respond to customer needs as they arise, then it follows that the company require a greater degree of responsiveness from its own suppliers. The achievement of delivery on time is a standard purchasing objective. If goods and material arrive late or work is not completed at the right time, sales may be lost, production halted and damages clauses may be invoked by dissatisfied customers leading to slow down the cash to cash cycle thus reducing the organization's efficiency or profitability. One of the critical roles of strategic sourcing is reducing on lead- time and improving on delivery to meet the customers demand. Lysons and Farrington (2006), define lead time as the period between a customer's order

and delivery of the final product. A small order of a pre-existing item may only have a few hours lead time, but a larger order of custom-made parts may have a lead time of weeks, months or even longer.

Lead time can mean the difference between making the sale and watching a competitor sign the contract. If a company can deliver the product weeks ahead of the competition, it stands a better chance of receiving future orders. Companies must remain realistic with their lead time estimates, but constantly strive to improve their manufacturing process or service provision and reduce lead times. Organizations face challenges when attempting to improve lead time on a product line. Some processes simply take more time to create a high quality product. It can be challenging to offer a competitive lead time to the customer while still maintaining [quality control](#) over production.

A competitive company must have both high quality goods and provide a high quality service by adding value to the chain. By reducing lead time and achieving faster delivery, the company's competitiveness will be enhanced. Within a supply chain context, delivery speed and reliability have become key requirements for competitive differentiation and increased profitability and these two factors will be used to measure the performance of the supply chain. Lead time, delivery time and on time delivery are all important SCM measures as their measurement will have dramatic impact on quality of SCM. Short lead time improves root-cause-corrective action systems. Short lead time also shorten the time from problem creation to problem detection. The shorter this time is, the greater the probability of identifying true root cause and implementing effective corrective actions. This results to increased capacity, throughput and sales. An organization can also use short lead time to justify premium pricing. ([Tummalaet...al, 2006](#), [Arnheiter and Maleyoff, 2005](#), [Lamming, 1996](#), [Chan et...al, 2002](#), Murgiano 2006).

Effective procurement plan

According to Baily, et...al, (2005), procurement plan is derived from the plans which have been formulated and should allow for subsequent comparison, evaluation and control of the efforts made to meet the company's objectives. In addition to that budget should be prepared in relation to relevant financial projections and overall company estimates with regards to e.g. return on investment.

PPOA (2009) defines procurement plan as document prepared by each procuring entity annually to plan all procurement requirements necessary to perform the activity plan of the procuring entity. Section 26 of the Act and Regulation 20 require a procurement plan to be prepared for each financial year as part of the annual budget preparation process. It is the responsibility of the head of department to submit an annual departmental plan to the accounting officer at least 30 days before the close of the financial year. Procurement plans should include a detailed breakdown of goods, works and services required and completion of delivery dates.

A multi- year procurement plans may be prepared and integrated into the medium term budgetary expenditure framework.

The benefits of good planning include: better alignment of procurement activities to strategic objectives, improved quality analysis for recommending a course of action, justifying the

project is worth doing, testing that implementation is realistic and achievable, detecting the potential impacts and pitfalls before starting knowing the sustainability of service or product design and delivery. An effective procurement plan provides an organized means whereby time and money are saved..It also provides a framework to that guides the achievement of tasks and duties. (Langford, 2010, Kakabadse, 2005).

III. RESEARCH DESIGN

Descriptive research design was used in this study. Data was collected through use of closed and open ended questionnaires that were distributed to JKUAT staff, The target population comprised of staff at the JKUAT main campus since that's where most of procurement is done. The JKUAT structure has classified the university staffs into four categories; top, middle, first line managers and the administrative staffs or staffs at the lower level. (Kothari, 2004, Orodho, 2005, Bennett 1993, Mugenda & Mugenda 2003)

Table 3.1 Target population

No.	Management level	Target population	Sample size
1	Top level management	50	15
2	Middle level management	80	24
3	First line managers	112	34
4	Other staffs	52	16
TOTAL		294	89

Source: Researcher (2015)

The study generated both qualitative and quantitative data through the research instruments. Based on the study objectives and questions, the massive qualitative data collected from the research tools was grouped into meaningful patterns that revealed how categories or themes were related (Verma & Mallick, 1999). Responses from the research tools both open and closed ended were tallied and counted according to themes. They were then analyzed using descriptive statistics such as percentages and frequency tables to produce quantitative data that gave a summary of the study findings. A multiple regression model was developed to describe the relationship between the dependent and independent variable. The regression equation was of the formula:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5$$

Where:

Y= Organization performance (reduced cost)

X1= Right quality of product and/service

X2=Cost of product and service

X3= Timely delivery of goods

X4= Supplier relationship

X5= Effective procurement plans

Statistical Package for social science [SPSS] was used for the analysis. Results were presented in terms of tables, graphs and pie charts.

IV. RESEARCH FINDINGS AND DISCUSSIONS

Respondents Gender

The researcher sought to establish the respondents' gender and the research findings indicated that, 55.1% were male while 44.9% were female.

Respondents age bracket

The respondents were requested to indicate their age bracket.

Table 4.1 Respondent age bracket

Respondents years	Frequency	Percentage
20-25	11	15.9%
26-35	16	23.2%
36-45	27	39.1%
46 and above	15	21.7%
Total	69	100%

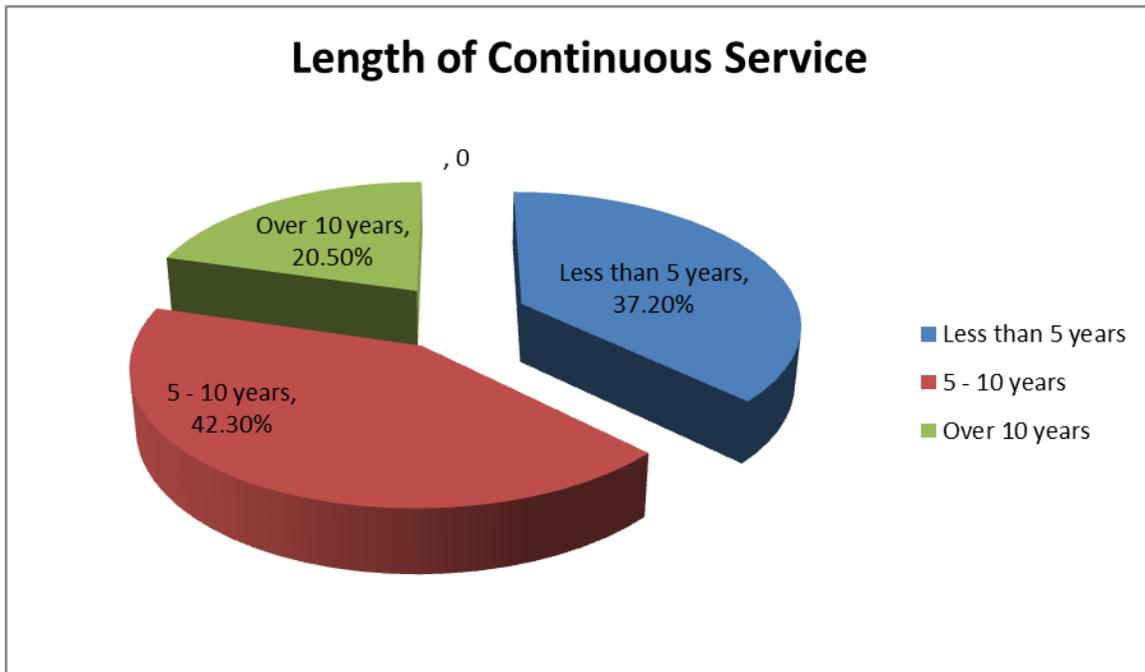
The results in table 4.1 indicates that 39.1% of the respondents were between 36-45 years, 23.2% of the respondents were between 26 and 35 years, 21.7% of the respondents were over 46 years while 15.9% of the respondents indicated that they were between 20-25 years. The results indicate that majority of the respondents were above forty years. With the majority of the staff being over 36 years, they will be nearing their retirement

age and it will be necessary for the organization to have to introduce younger staff in the levels of respondents to facilitate a flawless succession program and also introduce new views in the decision making process.

Length of continuous service with JKUAT

The respondents were requested to indicate the duration they have worked with JKUAT and the results are presented in figure 4.2.

Figure 4.1 Length of continuous services



The results in figure 4.2 indicates that 42.3% of the respondents have been working in the University for 5 to 10 years, 37.2% of the respondents indicated that they have worked in the University for over 10 years while 20.5% of the respondents indicate that they have worked in the University for less than 5 years. The results indicate that majority of the respondents have worked on the University for more than five years and thus they understand the role of strategic sourcing on organization's performance. The implication of this trend is that the companies need to come up with adequate knowledge management policy to preserve the acquired knowledge and retain the same in the case of a loss of an employee. The company should also include a mechanism of rotating the staff in all sections and avoid a situation where staff stay long in a section develop an 'empire building' situation.

Role of Strategic Sourcing on Organization's Performance

Strategic sourcing enables organizations to take advantage of a whole host of benefits and it is fast becoming the preferred model among organizations looking to focus on their core

competencies as well as reduce risk, improve quality of goods and services, timely delivery of goods and services, decrease costs, create a better supplier relationship and improve the efficiency and effectiveness of all the goods and services offered in the organization (Elmuti, 2003).

Quality of Supplies

The respondents were requested to indicate how quality of supplies influenced organization's performance in a likert scale. The range was 'too low(1)' to 'very high' (5). The scores of too low and low have been taken to represent a variable which had a mean score of 0 to 2.5 on the continuous likert scale; ($0 \leq V.L. < 2.4$). The scores of 'moderate' have been taken to represent a variable with a mean score of 2.5 to 3.4 on the continuous likert scale: ($2.5 \leq M < 3.4$) and the score of both high and very high have been taken to represent a variable which had a mean score of 3.5 to 5.0 on a continuous likert scale; ($3.5 \leq V.H. < 5.0$). A standard deviation of >0.7 implies a significant difference on the impact of the variable among respondents. The results represented in table 4.3.

Table 4.3 Quality of goods and services

Quality of Supplies	Mean	Std. Deviation
Are the employees satisfied by the quality of supplies sourced	4.0538	0.5303
Rate of the quality of supplies purchased by the organization	4.0436	0.6070
Extent at which quality of supplies affect the performance	3.4513	0.8041
If the University has put in place measures to manage quality supplies	3.9231	0.7344
Average Mean	3.8680	

From the table 4.3 the results obtained from the survey on the respondents to find out the role played by quality of supplies on organization’s performance show that the average mean was 3.8680 which implied that quality of supplies influenced organization’s performance. This is because the average mean ranged between $3.5 \leq V.H. < 5.0$ which was rated “very high”.

Cost of Goods and Services

The respondents were requested to indicate how cost of goods and services influenced organization’s performance in a likert scale. The range was ‘too low (1)’ to ‘very high’ (5). The

scores of too low and low have been taken to represent a variable which had a mean score of 0 to 2.5 on the continuous likert scale; ($0 \leq V.L. < 2.4$). The scores of ‘moderate’ have been taken to represent a variable with a mean score of 2.5 to 3.4 on the continuous likert scale: ($2.5 \leq M < 3.4$) and the score of both high and very high have been taken to represent a variable which had a mean score of 3.5 to 5.0 on a continuous likert scale; ($3.5 \leq V.H. < 5.0$). A standard deviation of > 0.7 implies a significant difference on the impact of the variable among respondents. The results are presented in table 4.4.

Table 4.4 cost of goods and services

Cost of Goods and Services	Mean	Std. Deviation
How does the university source its supplies	3.7542	0.6153
Prices reflect market price and value for money	4.1531	0.6070
Extent at which cost of supplies affect competitiveness	3.6568	0.8041
If there are other practices that can be employed to secure supplies at a more favourable price	3.7890	0.7344
Average Mean	3.8383	

From the table 4.4 the results obtained from the survey on the respondents to find out the role played by cost of goods and services on organizational performance show that the average mean was 3.8383 which implied that cost of supplies influenced organization’s performance. This is because the average mean ranged between $3.5 \leq V.H. < 5.0$ which was rated “very high”. However, the standard deviation was too high which was indication that there were discrepancies on the impact of the variables among the respondents.

Supplier Relationship

The respondents were requested to indicate how supplier relationship influenced organization’s performance in a likert

scale. The scores of too low and low were taken to represent a variable which had a mean score of 0 to 2.5 on the continuous likert scale; ($0 \leq V.L. < 2.4$). The scores of ‘moderate’ have been taken to represent a variable with a mean score of 2.5 to 3.4 on the continuous likert scale: ($2.5 \leq M < 3.4$) and the score of both high and very high have been taken to represent a variable which had a mean score of 3.5 to 5.0 on a continuous likert scale; ($3.5 \leq V.H. < 5.0$). A standard deviation of > 0.7 implies a significant difference on the impact of the variable among respondents. The results are presented in table 4.5.

Table 4.5 Supplier relationship

Supplier Relationship	Mean	Std. Deviation
Does the university embrace supplier relationship	3.1540	0.5670
Type of relationship university maintains with the suppliers	3.7253	0.7529
If the current supplier relationship maintained influence supplier relationship	3.4514	0.8589
Rate at which the supplier performance influence organizational performance	3.2634	0.6689
Average Mean	3.3985	

From the table 4.5 the results obtained from the survey on the respondents to find out the role played by supplier relationship on organizational performance show that the average mean was 3.3985 which implied that supplier relationship had a moderate influence on organizational performance. This is because the average mean was between $2.5 \leq M < 3.4$ which was rated “moderate”. However the standard deviation was too high which was indication that there were discrepancies on the impact of the variables among the respondents.

Timely Delivery of Goods and Services

The respondents were requested to indicate how timely delivery of goods and services influenced organization’s

performance in a likert scale. The scores of too low and low were taken to represent a variable which had a mean score of 0 to 2.5 on the continuous likert scale; ($0 \leq V.L < 2.4$). The scores of ‘moderate’ have been taken to represent a variable with a mean score of 2.5 to 3.4 on the continuous likert scale: ($2.5 \leq M < 3.4$) and the score of both high and very high have been taken to represent a variable which had a mean score of 3.5 to 5.0 on a continuous likert scale; ($3.5 \leq V.H < 5.0$). A standard deviation of > 0.7 implies a significant difference on the impact of the variable among respondents. The results are represented in table 4.6.

Table 4. 6 Timely delivery of goods and services

Timely Delivery of Goods and Services	Mean	Std. Deviation
Do suppliers meet on time fully delivery	3.5810	0.1574
Rate at which timely delivery of goods and services affects organizational performance	3.6580	0.2985
Average Mean	3.6195	

From the table 4.6 the results obtained from the survey on the respondents to find out the role played by timely delivery of goods and services on organizational performance show that the average mean was 3.6195 which implied that timely delivery of goods and services had a very high influence on organizational performance. This is because the average mean was between $3.5 \leq M < 5.0$ which was rated “very high”. However the standard deviation was too low which was indication that there were no or little discrepancies on the impact of the variables among the respondents. When asked what led to late payment of suppliers, the respondents indicated late payments of credits and initiation of procurement on when cash flow is health and budgetary allocation were suggested by most of the respondents to avoid late payments.

Effective Procurement Plan

The respondents were requested to indicate how effective procurement plan influenced organizational performance in a likert scale. The scores of too low and low were taken to represent a variable which had a mean score of 0 to 2.5 on the continuous likert scale; ($0 \leq V.L < 2.4$). The scores of ‘moderate’ have been taken to represent a variable with a mean score of 2.5 to 3.4 on the continuous likert scale: ($2.5 \leq M < 3.4$) and the score of both high and very high have been taken to represent a variable which had a mean score of 3.5 to 5.0 on a continuous likert scale; ($3.5 \leq V.H < 5.0$). A standard deviation of > 0.7 implies a significant difference on the impact of the variable among respondents. The results are represented in table 4.7.

Table 4.7 Effective procurement plan

Effective Procurement Plan	Mean	Std. Deviation
Does the university develop a procurement plan	4.0148	0.4210
Does the organization adhere to the developed plan	3.6451	0.2545
How effective is the procurement plan	2.9854	0.6892
If the department participate in the development of University’s strategic management plan	3.3568	0.4568
Extent at which procurement plan is linked to strategic plan of the University	3.4125	0.6157
Average Mean	3.4829	

From the table 4.7 the results obtained from the survey on the respondents to find out the role played by effective procurement plan on organization’s performance show that the average mean was 3.4829 which implied that effective procurement plan had a moderate influence on organization’s performance. This is because the average mean was between

$2.5 \leq M < 3.4$ which was rated “moderate”. The standard deviation was low, an indication that there were few discrepancies on the impact of the variables among the respondents.

Summary of the Role of Strategic Sourcing

Table 4.8 Summary role the strategic sourcing

Role of Strategic Sourcing	Average Mean
Quality of goods and services	3.8680
Cost of goods and services	3.8383
Supplier relationship	3.3985
Timely delivery of supplies	3.6195
Effective procurement plan	3.4829

The results in table 4.3 indicate that roles considered by JKUAT strategic sourcing was quality of goods and services (average mean 3.8680), cost of goods and services (average mean 3.8383), timely delivery of goods and services (average mean 3.6195), effective procurement plan (average mean 3.4829), and supplier relationship (mean 3.3985). This study shows that quality of goods was the highly rated role of strategic sourcing followed by cost of goods, timely delivery of supplies, effective procurement plan and lastly supplier relationship. There

low variation of standard deviation in most of the variables. This indicated that the respondents were unanimous on the role of strategic sourcing on organization’s performance.

Regression Analysis

The roles of strategic sourcing were investigated from the results of the respondents. From Table 4.9 below, the established multiple linear regression equation becomes:

$$Y = -0.887 + 0.07X_1 + 0.009X_2 + 0.14X_3 + 1.008X_4 + 0.006X_5$$

Table 4.9 Results of general least square

Model 1	Un-standardized Coefficients		Standardized Coefficients	
	B	Std. Error	Beta	t
(Constant)	-.887	.618		-1.436
X ₁	.007	.006	-.349	-1.249
X ₂	.009	.006	-.585	-1.566
X ₃	.140	.005	-.017	-.061
X ₄	.008	.006	.568	1.349
X ₅	.006	.004	.328	1.135

Source: Researcher 2015

The intercept of the vertical axis has a value (-0.887) and means that that the point where the independent variables is zero then the performance will be negative. The coefficient of all the independent variables are positive at $\alpha = 5\%$, and implies that the increase in the independent variables results in an increase in

the university’s performance. From the coefficients, it can be deduced that the most critical role of strategic sourcing is quality of goods and services which affects an organizations performance at a higher rate than other variables.

Table 4.10 Model summary

Model	R	R Square	Adjusted Square	R	Std. Error of the Estimate	F-statistic
1	.664 ^a	.4409	.339	.2296886	59.4	

Source: Researchers’ computation

The R², also called the coefficient of determination, is the percentage of the variance in the dependent variable explained uniquely or jointly by the independent variables and is 66.4 %. This means that 66.4 % of the changes in the university strategic sourcing are explained by the changes in the independent variables in the model. The remaining 33.6% of the changes in the Y is explained by other factors not in the model. The C is the constant, where the regression line intercepts the y axis, representing the amount the dependent y will be when all the independent variables are 0. Here C is -0.887; the probability of

the coefficient is significant. The F statistic is used to test the significance of R. Overall; the model is significant as F-statistics is 59.4.

V. SUMMARY OF FINDINGS

The study found out that strategic sourcing has a role to play in organization’s performance. In order to meet the standards the university desires, the university need to consider: quality of goods and services, the cost of goods and services,

supplier relationship, timely delivery of goods and services and effective procurement plan.

Strategic sourcing enables the organization to concentrate on its core functions which enable the company to achieve strategic advantage and at the same time act as a means in which a business conditions or problems can be alleviated in a manner that is more efficient or effective.

Although strategic sourcing is essential to the university, the respondents indicated that quality of goods and services was the most highly rated variable followed by cost of goods and services, timely delivery of supplies, effective procurement plan and lastly supplier relationship in that order. The performance of strategic sourcing was indicated as being affected by poor planning, failure to adhere to procurement plans, inadequate funding, sourcing before being really ready and increase in costs of administering the sourcing function.

VI. CONCLUSION

The broad research questions relating to the role of strategic sourcing on an organization's performance was studied and the findings were analysed so as to draw conclusions. The study established that strategic sourcing was affected by various factors which include quality of goods and services, cost of goods and services, supplier relationship, timely delivery of goods and services and the effective planning and adherence to the procurement plans.

In establishing the role of quality goods and services on the organization's performance, it was concluded that quality of goods and services plays a very major role in determining the organization performance. Substandard goods and services translate to more cost incurred, wastages and this could mean loss of business to a competitor.

The research also indicated that the university sources its supplies competitively and this affects the final price charged on the goods and services offered by the university. Hence the cost of goods and services sourced affect university competitiveness. Strategic sourcing is attractive to senior management and it's a top level decision making hence it can be used to improves some of the dimensions of organization's performance. This is evident especially in resource allocation as contained in the annual procurement plans generated by each and every department. However, with the fluctuation in prices, increased demand of higher education in the country and continued under funding from the government, the institution is forced to adjust its budget.

VII. RECOMMENDATIONS

Based on the research findings, the following recommendations should be considered as the university work towards maximizing on the benefits of the strategic sourcing:

1. The university should maximize on its human capital as it most priced asset. The research identified that majority of its staff are well educated and it should therefore ensure that it retain them so as to maximize on their expertise.
2. The study found out that the university's strategic sourcing was affected by factors resulting from non-

adherence to planning and sourcing process and it is therefore recommends that the university should have a formal strategic sourcing process so that they can make decisions which would result to management of risks and securing added value and continuous improvement.

3. The study established that the university is faced with delays in payment of suppliers, difficult procurement process which takes a lot of time and emergencies purchases and sometimes above the planned request. It is therefore recommended that JKUAT should put all measures in place to ensure that they do not face severe losses as a resulting from poor supplier relationship.
4. It is further recommended that instead of competitive sourcing, a framework contract can be employed so that value for money can be realized.
5. Finally, the management should ensure that respective department should prepare well planned budget and operate within the budget and funds allocated.

7.4 Recommendations for Further Research

The study was on Jomo Kenyatta University of Agriculture and Technology which is a public university and a public entity. This research therefore should be replicated in other public universities and other public entities and the results be compared so as to establish whether there is consistency among the universities on the role of strategic sourcing on organization's performance. This is because private universities do not have bureaucratic procedures when it comes to strategic sourcing.

It's important for a further research to investigate the role of a competent and productive human resource towards implementation of such reforms for an enhanced performance. Future researchers should also embark on researching the risks associated with strategic sourcing and factors inhibiting strategic sourcing in both private and public sectors.

REFERENCES

- [1] Arif Khan K, Rajesh, K. Pillania, (2008) Strategic sourcing for supply chain agility and firms' performance: A study of Indian manufacturing sector, *Management Decision*, Vol. 46 Iss: 10, pp.1508 – 1530
- [2] Baily, P., Farmer, D., Jessop, D. and Jones, D (2005). *Purchasing principles and management*. (9th Edition). Prentice Hall: London.
- [3] Bartlett, Kotlik, & Higgins (2000), Table for Determining Minimum Returned Sample Size for a Given Population Size for Continuous and Categorical Data. *Information Technology, Learning, and Performance Journal*, Vol. 19, No. 1, 43-50. Retrieved on August 15, 2014 from www.instatmy.org/database
- [4] Boateng, D. (2012) *Improving Acquisition through Strategic Sourcing*. Retrieved on 20th September 2014, from the white house website, <http://www.whitehouse.gov>
- [5] Chiang, C. Y. et. al (2006) Strategic Sourcing: An Empirical Investigation of the Concept and Its Practices in U.S. Manufacturing Firms. *International Journal of Operations & Production Management* 01/2012; 32(1):49-78. • 1.13 Impact Factor. Retrieved on 14th September 2014 from Wiley online library database
- [6] Chopra, S. and Meindl, P. (2003) *Supply Chain Management*, [Electronic version]. USA: Prentice Hall
- [6] Deephouse, D.L. (1999), "To be different, or to be the same? It's a question (and theory) of strategic balance", *Strategic Management Journal*, Vol. 20 pp.147-66.

- [7] DiMaggio, P.J., Powell, W.W. (1983), "The iron cage revisited: institutional isomorphism and collective rationality in organizational fields", *American Sociological Review*, Vol. 48 No.2, pp.147-60.
- [8] Edward, O. O. (2011) From passive to active stakeholders: citizen accountability mechanisms in procurement process in Kenya from A new role for citizens in public procurement [Electronic version] *Transparencia Mexicana: Mexico Eisenhardt, K.M. (1989), "Agency theory: an assessment and review", Academy of Management Review*, Vol. 14 pp.57-74.
- [9] Elmuti, D. (2003), "The perceived role of strategic sourcing on organizational performance", *Mid-American Journal of Business*, Vol. 18 No.2, pp.33-7
- [10] Faes, W. and Matthyssens, P. (2009) insight into the process of changing strategies. *Journal of business and industrial marketing*, Vol, 24 No. 3, pp.245-255.
- [11] Nabhani, F. and, Shokri, A (2009) "Reducing the delivery lead time in a food distribution SME through the implementation of six sigma methodology", *Journal of manufacturing technology management*, Vol. 20 Iss: 7, pp.957 – 974
- [12] Gimeno, J., Woo, C.Y. (1996), "Hyper competition in a multimarket environment: the role for strategic similarity and multimarket contact in competitive de-escalation", *Organization science*, Vol. 7 pp.322-41.
- [13] Gulati, R., Nohria, N., Zaheer, A. (2000), "Strategic networks", *Strategic management journal*, Vol. 21 pp.203-15.
- [14] Hult, G.T., Ketchen, D., Cavusgil, S., Calantone, R. (2006), "Knowledge as a strategic resource in supply chains", *Journal of Operations Management*, Vol. 24 No.5, pp.458-75.
- [15] International Statistical Institute's 49th Session, Florence.
- [16] Jin Su, (2013) "Strategic sourcing in the textile and apparel industry", *Industrial management & data systems*, Vol. 113 Iss: 1, pp.23 – 38
- [17] Jin Su, Vidyaranya B. Gargeya, (2012) "Strategic sourcing, sourcing capability and firm performance in the US textile and apparel industry", *Strategic Outsourcing: An International Journal*, Vol. 5 Iss: 2, pp.145 – 165. Retrieved February, 27, 2014, from emerald insight database.
- [18] Jomo Kenyatta University of Agriculture and Technology (2014) JKUAT history: General information. Retrieved on July, 18, 2014 from Jomo Kenyatta University of Agriculture and Technology website, <http://www.jkuat.ac.ke>
- [19] Kenya Gazette Supplement No. 77 (Acts No. 3) (2005). The Public Procurement and Disposal Act No. 3 of (2005), retrieved on 4th September 2014 from the public procurement oversight authority (PPOA) website <http://ppoa.go.ke/>.
- [20] Kothari, C. R. (2004), *Research methodology: methods and techniques*, New Delhi: New Age International (P) Limited, Publishers
- [21] Logan, M. (2000), "Using agency theory to design successful outsourcing relationships", *International Journal of Logistics Management*, Vol. 11 No.2, pp.21-32.
- [22] Lundberg, C.C. (2004), "Is there really nothing so practical as a good theory?", *Business Horizons*, Vol. 47 No.5, pp.7-14.
- [23] Lysons, B. and Farington, B. (2006). *Purchasing and supply chain management*. Harlow Essex: Prentice Hall
- [24] March, J.G., Olsen, J.P. (1984), "The new institutionalism: organizational factors in political life", *American Political Science Review*, Vol. 78 pp.734-49.
- [25] Mugenda, A. and Mugenda, O. (2003) *Research methods quantitative and qualitative approaches*. Nairobi: Acts Press.
- [26] Orodho, A. J., (2005). *Essentials of educational and social sciences research method*. Nairobi: Masola Publishers.
- [27] Pillania, R. (2007), *Leveraging Which Knowledge in the Globalization Era? Indian Facet The Learning Organization* .14 (4):313-321
- [28] Porter, M.E. (1996), "What is strategy?", *Harvard Business Review*, Vol. 74 No.6, pp.61-78.
- [29] Jakovljevic, P. (2008), *Distinctions and Benefits of Strategic Sourcing, from technology and evaluation's Research and Reports TEC Blog*. Retrieved On 5, 3, 2014 from [Http://www.Technologyevaluation.Com](http://www.Technologyevaluation.Com)
- [30] Scott, C., Westbrook, R., 1991. *New strategic tools for supply chain management*. *International Journal of Physical Distribution and Logistics* 21 (1), 23}33
- [31] Thomas, H. S. and A.T. Kearney (2006), *The Future of Purchasing and Supply: Strategic Sourcing*, from the ISM online Magazine. Retrieved on 4, 3, 2014 from www.ism.ws
- [32] Van Weele, A.J., (1998) *New Concept in measuring purchasing*. *Journals of purchasing and materials management*
- [33] Verma & Mallick (1999). *Researching Education: Perspectives and Techniques*; Falmer Press: London.
- [34] Vijay, R. and Kannan, K. T. (2006) "Buyer-supplier relationships: The impact of supplier selection and buyer-supplier engagement on relationship and firm performance", *International Journal of Physical Distribution & Logistics Management*, Vol. 36 Iss: 10, pp.755 – 775.

AUTHORS

First Author – Titus Wachira Kihanya, Assistant procurement officer, Jomo Kenyatta University of Agriculture and Technology, P.O Box 81310-80100, Mombasa, Email: tkihanya@jkuat.ac.ke

Second Author – Moses Kimani Wafula, Senior Assistant Librarian, Jomo Kenyatta University of Agriculture and Technology, P.O Box 81310-80100, Mombasa, Email: wafulak@jkuat.ac.ke

Third Author – Evans Ojiambo Onditi, Lecturer Jaffery Institute of Professional Studies, P.O Box 82522-80100, Mombasa, Email: evanso1982@gmail.com

Fourth Author – Ambrose Muriithi Munene, Jomo Kenyatta University Mombasa Campus, P.O. Box 16778-80100, Mombasa, Email: ambumuriti@gmail.com

Effects of Internet Banking on the Financial Performance of Commercial Banks in Kenya a Case of Kenya Commercial Bank

Stephanie Kadzo Kombe and Moses Kimani Wafula

* Revenue Accountant Kenya Power LTD, P.O. Box 920104-80100, Mombasa

** Senior Assistant Librarian, Jomo Kenyatta University of Agriculture and Technology Mombasa CBD, 81310-80100-Mombasa, Kenya

Abstract- Financial institutions have been in the process of significant transformation. Despite this transformation, even though there's a richness of information on the nature and scope of internet banking, there is a scarcity of evidence about the impact of internet banking activities among banks that have adopted it compared to those that have not done so. The research aimed at determining the effects of internet-banking on financial performance of financial institutions in Kenya. The study adopted a descriptive survey design. The target population comprised of 31 employees of KCB, Treasury Square in Mombasa Kenya. Data collection was done through the use of questionnaires and analyzed using statistical tool. From the study, it was revealed that the impact of ICT adoption on the performance of banking sector mainly refers to time reductions and quality improvements, rather than cost reductions as reported by many authors.

Index Terms- internet banking, e-banking, mobile banking, banking information systems

I. INTRODUCTION

The revolution of information technology has influenced almost every facet of life, among them is the banking sector. The introduction of electronic banking has revolutionized and redefined the ways banks were operating. As technology is now considered as the main contribution for the organizations' success and as their core competencies. All the banks considered observed that cost reduction and enhanced ability to deal with customers were drivers of extreme importance. Yaklef, (2001) identified cost reduction as an inherent benefit to banking. The desire to reduce both operational and administrative costs has driven banks to the electronic world. However, cost reduction is only realizable with an increase in consumer adoption (Stewart, 2003, Yaklef, 2001, FinCen, 2000).

Internet banking (e-banking) is the use of internet and telecommunication networks to deliver a wide range of value added products and services to bank customers. Internet banking includes importing data into personal accounting software. Some online banking platforms support account aggregation to allow the customers to monitor all of their accounts in one place whether they are with their main bank or with other institutions. Banking through internet is considered as a complimentary delivery channel for the services rather than a substitute for the brick and mortar banking branches. Internet has changed the

dimensions of competition in the retail banking sector. Following the introduction of PC banking, ATMs and phone banking, which are the initial cornerstones of electronic finance, the increased adoption and penetration of Internet has added a new distribution channel to retail banking: Internet/Online-banking. Internet banking has gained worldwide acceptance as a new delivery channel for performing various banking transactions. It provides the opportunity to the customers to conduct banking transactions at their convenience. There are two ways to offer Internet banking. First, an existing bank with physical offices can establish a website and offer Internet banking in addition to its traditional delivery channels. Second, a bank may be established as a "branchless," "Internet-only," or "virtual" bank (DeYoung, 2001, Allen et al, 2002, Steven, 2002)

Internet banking is called transactional online banking, because it involves provision of facilities such as accessing accounts, funds transfer and buying financial products or services online. The Internet also helps banks penetrate other financial markets without requiring their physical presence in those markets. The widespread availability of Internet banking is expected to affect the mixture of financial services produced by banks, the manner in which banks produce these services and the resulting financial performances of these banks. This therefore is seen by banks as a better means to serve its wide and ever-growing customer base with quality service, fast, efficient and convenient manner. It is also believed to create a good revenue to banks thus leading to profitability. In addition, industry analysis outlining the potential impact of Internet banking on cost savings and risk profile of the banks have also generated considerable interest and speculation about the impact of the Internet on the banking industry. (Berger, 2003(Karjaluo, Mattila and Pento, 2001, Simpson, 2002).

Online banking through traditional banks enables customers to perform all routine transactions, such as account transfers, balance inquiries, bill payments, and stop-payment requests, and some even offer online loan applications. Customers can access account information at any time, day or night, and this can be done from anywhere. Internet banking has improved banking efficiency in rendering services to customers. Financial institutions in Kenya cannot ignore information systems since they play an important role in their operations because customers are conscious of technological advancements and demand higher quality services. Miklaszewska (1998) identified four roles for the Internet in a modern banking industry. First, it facilitates financial transactions between banks and their consumers. Second, it gives financial institutions permanent access to

financial information. Third, the Internet connects a bank's head office to its branches. Finally electronic banking lets customers check their account information, pay bills, transfer funds between accounts, and perform other functions. Customers will soon have access to additional services such as online stock and bond trading (Miklasewska, 1998).

In Kenya a recent survey indicates that there is steady increase in use of e-banking technologies such as automated teller machine (ATM), mobile and Internet (online) banking, electronic funds transfer, direct bill payments and credit card (CBK 2008). ATM banking is one of the earliest and widely adopted retail-banking services in Kenya (Nyangosi et al. 2009). However, according to an annual report by Central Bank of Kenya (CBK), its adoption and usage has been surpassed by mobile banking (M-banking) in the last few years (CBK 2008). Currently, there are about 8 million users of M-banking services compared to 4 million people who hold accounts in conventional financial institutions in Kenya (CBK 2008). The tremendous increase in number of people adopting M-banking has been attributed to ease of use and high number of mobile phone users. This is consistent with the theory of consumer choice and demand as conceptualized in Au and Kauffman (2008) in relation to mobile payments. Based on their observation, customers can choose to adopt a particular banking technology such as M-banking, perceived to offer such advantages as ease of use. (Kolodinsky and Hogarth 2001).

Since the introduction of e-banking in Kenya, financial institutions have witnessed many changes. Customers now have access to fast, efficient and convenient banking services. They have realized that a company that ignores customer needs and preferences in its products development would be deemed to fail (Agarwal et al. 2009). However while the rapid development of ICT has made some banking tasks more efficient and cheaper, technological advancements have their fair share of problems. Gupta (2000), Aladwani (2001) and Hwang et al. (2003), cited that internet security and customer related issues are the greatest challenges facing banking sectors. This is true in Kenya since e-banking in Kenya is still developing thus the focus of most banks is on setting up the systems giving less attention to the industry technical issues. Thus there is a need to manage costs and risks associated with internet banking. It is crucial that internet banking innovations be made through sound analysis of risks and costs associated to avoid harm on banks performance. The influence of internet-activities of banks on their performance continues to be insignificant irrespective of what is used as performance variable following banking literature and industry norms for bank performance definitions in Kenya. However the research on the adoption of internet banking by the consumers has been vast, while there has been very limited research on the effects of internet banking on the bank profitability especially within the Kenyan context. Thus, this study sought to explore the effects of internet banking on the financial performance of commercial banks in Kenya.

II. OBJECTIVES

General objective

The purpose of the study was to establish the effects of internet banking on the financial performance of commercial banks in Kenya.

Specific objectives

- i. To establish the effect of cheaper internet connectivity on performance of banks.
- ii. To determine the effects of 24 hour e-banking to the overall financial performance of commercial banks.
- iii. To determine effects of the ICT competence of the customers on the financial performance of banks.

a) LITERATURE REVIEW

Recent literature has a narrow focus and ignores internet banking almost entirely; it equates internet money with the substitution of currency with internet gadget. For instance Freedman (2000) suggests that internet banking and internet money consists of three devices; access devices, stored value cards, and network money. Internet banking is simply the access to new devices and is therefore ignored. Internet money is the sum of stored value (smart cards) and network money (value stored on computer hard drives). According to a survey by KPMG (1999), the evolution of Internet-banking can be analyzed within a five-stage conceptual framework, where the extent of services provided through Internet start from a promotional stage and extend to transaction-enabled business innovation stage in where value-chains are redesigned in the process and offer highly personalized products and services. Analyzing the consumer side, Birch and Young (1997) show that consumers seek convenience, transactional efficiency, a choice of core banking products and non-core products, and access to competitive returns and prices. On the other hand, Wright (2002) mentions that Internet-banking has lifted the branch network as an entry barrier to the retail banking while introducing price transparency as customers can now easily compare prices online. In order to adopt internet technology as an id in the banking sector, the following models need to be looked at to facilitate smooth adoption of the innovation in order to maximize profits and provide quality banking services to clients.

2.2.1 Innovation diffusion theory

Mahajan and Peterson (2010) defined an innovation as any idea, object or practice that is perceived as new by members of the social system and defined the diffusion of innovation as the process by which the innovation is communicated through certain channels over time among members of social systems. Diffusion of innovation theory attempts to explain and describe the mechanisms of how new inventions in this case internet banking is adopted and becomes successful. Sevcik (2004) stated that not all innovations are adopted even if they are good it may take a long time for an innovation to be adopted. He further stated that resistance to change may be a hindrance to diffusion of innovation although it might not stop the innovation it will slow it down. There are five critical attributes that greatly influence the rate of adoption. These include relative advantage, compatibility, complexity, triability and observability. The rate of adoption of new innovations will depend on how an organization perceives its relative advantage, compatibility, triability, observability and complexity. If an organization in Kenya observes the benefits of mobile and internet banking they will adopt these innovations given other factors such as the availability of the required tools. Adoption of such innovations

will be faster in organizations that have internet access and information technology departments than in organizations without. (Rogers 2005, Clarke (2005)

2.2.2 Transactions Cost Innovative Theory

The transaction cost innovation theory pioneered by Niehans (2006) advocated that the dominant factor of financial innovation is the reduction of transaction cost, and in fact, financial innovation is the response of the advance in technology which caused the transaction cost to reduce. The reduction of transaction cost can stimulate financial innovation and improvement of financial service. It states that financial innovation reduces transaction costs. Transaction costs Innovation theory is also relevant in this context: for instance, the use of Internet-connected Information Technology (IT) can substantially reduce a firm's transaction costs as it enables efficient coordination, management and use of information. Mobile, Internet-connected IT may further lower transaction costs as it provides also off-site access to the firm's internal database and other relevant sources of information. Consequently, reduction of operation costs through agency banking, internet banking and mobile banking may influence growth in profitability for the bank.

2.2.3 Constraint-Induced Financial Innovation Theory

This theory pointed out that the purpose of profit maximization of financial institution is the key reason of financial innovation. There are some restrictions however in the process of pursuing profit maximization. These may include but not limited to policy and internal organizational management. Constraint-induced innovation theory discussed the financial innovation from microeconomics, so it is originated and representative. However, it emphasized "innovation in adversity"

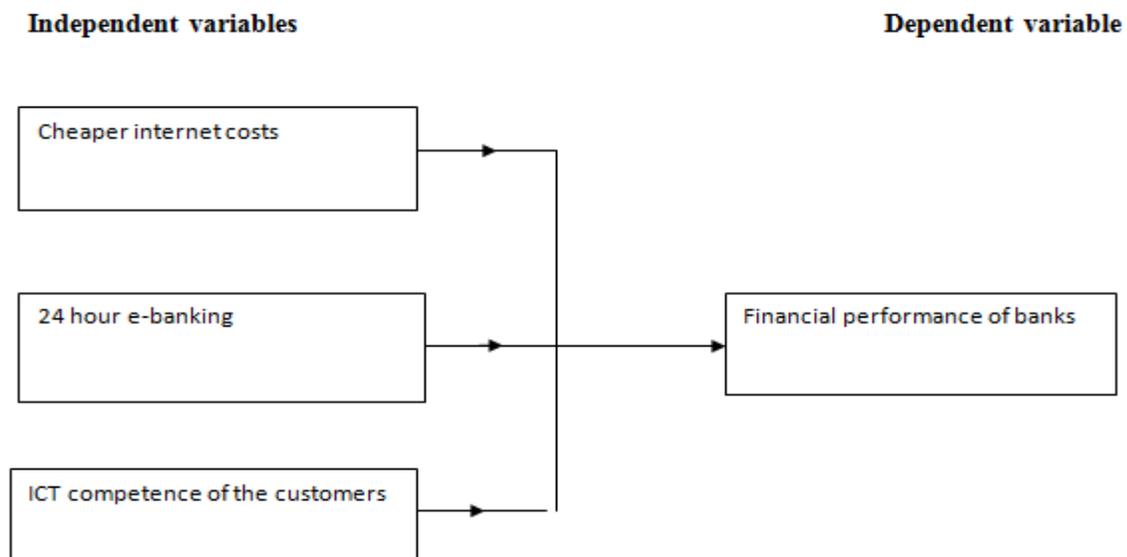
excessively so it can't express the phenomenon of financial innovation increasing in the trend of liberal finance commendably. Financial constraints significantly reduce the probability that a firm undertakes innovative projects. However, according to Silber (2004) financial innovation occurs to remove or lessen the constraints imposed on firms. Firms facing imperfections (e.g. regulation, entry barriers) have the greatest incentive to innovate and boost profits because of the high shadow costs of such constraints. (Silber 2004)

2.2.4 Information production and contemporary banking theory

Diamond (2002) suggested that economic agents may find it worthwhile to produce information about possible investment opportunities if this information is not free; for instance surplus units could incur substantial search costs if they were to seek out borrowers directly. Contemporary banking theory suggests that banks, together with other financial intermediaries are essential in the allocation of capital in the economy. This theory is centered on information asymmetry, an assumption that "different economic agents possess different pieces of information on relevant economic variables, in that agents will use this information for their own profit" (Freixas and Rochet, 2008). Asymmetric information leads to adverse selection and moral hazard problems. Asymmetric information problem that occurs before the transaction occurs and is related to the lack of information about the lenders characteristics, is known as adverse selection. Moral hazard takes place after the transaction occurs and is related with incentives by the lenders to behave opportunistically. Bhattacharya and Thakor (2003)

2.3 Conceptual framework

Fig. 2.1: Relationship between variables



2.3.1 Effects of cheaper internet costs on financial performance of commercial banks

The rapid development of the technology infrastructure, in particular the growth in the number of personal computers, the increased quality of Internet connections, the more widespread use of the Internet in both homes and businesses, and the significant reduction in both the fixed and variable costs of the Internet connections in Kenya, have made it possible for the Internet to play a more central role in banks' business strategy Delgado and Nieto (2004).

Kenyan banks benefited particularly from the adoption of the Internet because of their universal character. As with many European banks –unlike US banks prior to enactment of the Gramm-Leach-Bliley Act of 1999–, Kenyan banks have enjoyed the advantages of "broad banking" Barth, Brumbaugh and Wilcox (2000). Banks have been allowed to offer all sorts of financial products and engage in a wide variety of financial business (including securities trading and mutual funds management). Carbó and Rodríguez (2005) find that cost and profit global scope economies improve significantly when including mutual funds along with other earning assets, showing certain cross-selling and portfolio diversification benefits in the Kenyan banks.

The main economic argument for adopting the Internet as a delivery channel is based on the expected reduction in overhead expenses made possible by reducing and ultimately eliminating physical branches and their associated costs (e.g. staff and rent). This is particularly relevant in the Kenyan banking system the Internet delivery channel may generate scale economies in excess of those available to traditional distribution channels. The unit costs of Internet banking fall more rapidly than those of traditional banks as output increases as a result of balance sheet growth. In this context, DeYoung, Lang and Nolle (2006) refer to the Internet banking as a process innovation that functions mainly as a substitute for physical branches for delivering banking services.

2.3.2 Effects of 24 hour e-banking on financial performance of commercial banks

Internet banking by its nature offers more convenience and flexibility to customers coupled with a virtually absolute control over their banking. Service delivery is informational (informing customers on bank's products, etc) and transactional (conducting retail banking services). As an alternative delivery conduit for retail banking, it has all the impact on productivity imputed to Telebanking and PC-Banking. Aside that it is the most cost-efficient technological means of yielding higher productivity. Furthermore, it eliminates the barriers of distance / time

and provides continual productivity for the bank to unimaginable distant customers since it is accessible on a 24 hour basis.

2.3.3 Effects of ICT competence of customers on financial performance of commercial banks

Information and Communication Technology (ICT) is fast becoming a dynamic channel that drives the Kenyan economy. ICT is becoming increasingly important for the growth of our economy as a whole. The availability and usage of adequate ICT skills are important factors, which influence the competitiveness among commercial banks in this era of e-Economy. Availability of skilled labor is a questionable resource requirement. There is a qualitative and quantitative imbalance in the supply of skilled labor and computer literacy amongst customers. It depends on the demographic factors, business cycles and rapid technological advancements taking place around us. Due to the vast development in the area of e-Banking it is essential that the policy makers should focus on the growing demand in ICT skills and take corrective steps to prepare the required numbers and quality beforehand. e-Banking enables to conduct banking business electronically over the Internet where the costs are minimal and it is no longer bound by time or geographical boundary. The target customers should as well equally be knowledgeable on the essential skills of applying Information Technology for the success of e-banking. (Malden and Jayasena, 2009)

b) RESEARCH DESIGN AND METHODOLOGY

Research design

The study adopted a descriptive research design which describes the state of affairs as they exist at present. The descriptive research design formulates the problem for more precise investigation and in this case was to explore the impact of internet banking on the financial performance of commercial banks in Kenya. (Berinsky, 2008).

Target Population

The population is the larger set of observations while the smaller set is referred to as the sample. The target population comprised of employees of Kenya Commercial Bank, Treasury square branch Mombasa. (Cooper & Schindler 2008, Berinsky, 2008)

Sampling frame

The researcher used a sample size of 31 respondents representing 60.7% from a target population that totaled to 51 respondents. This was obtained from the different departments in the Bank. This number represents the target population for purpose of reliability, flexibility and efficiency (Mugenda, 2008, Dillman, et al 2011).

Table 3.1 Sampling frame

Department	Population	Ratio	Sample	Percentage (%)
Operations	22	0.6	13	41.9
Marketing	17	0.6	10	32.3
Finance	6	0.6	4	12.9
ICT	6	0.6	4	12.9
TOTAL	51	0.6	31	100

Source: Researcher (2015)

III. RESEARCH FINDINGS AND DISCUSSIONS

The study comprised 31 respondents in collecting data with regard to the effects of internet banking on bank’s performance.

Response rate

Table 4.1: Illustrating the percentage of response rate.

Number of questionnaires distributed	Number of questionnaires returned	Percentage
31	31	100%

From the study, all the sampled respondents filled in and returned the questionnaires making a response rate of 100%.

Respondent’s experience

The table bellow shows how long the respondents have served in the bank. It is very important characteristics because respondents are able to monitor the performance of their company.

Table 4.2: Number of years respondents worked in the bank.

Number of years worked in the bank	frequency	Percentage
0-2 years	4	12.9%
2-4years	6	19.4%
4-6years	8	25.8%
6 and above years	13	41.9%
Total	31	100%

From table 4.2 above it can be observed that 41.9% of the respondents had served the bank for above 6 years, while 25.8% respondents had served the bank for 4-6 years, 19.4% of the respondents had served the bank for 2-4 years and 12.9% of the respondents had served the bank for 0-2 years. This indicates that majority of the respondents have served the bank for at least 6 years and above.

diploma holders. In its innovative quest the bank has been able to attract educated employees as others have gone up to the Master’s level as shown by the 12.9% representing 4 respondents.

IV. DESCRIPTIVE ANALYSIS OF INDEPENDENT VARIABLES

Figure 4.3: Employee’s level of education

Most of the employees in the bank were degree holders. They constituted 48.4% representing 15 respondents from the sampled population, 25.8% representing 8 respondents were

Cheap internet costs and financial performance of banks

This shows the relationship between cheap internet costs and its effect on the banks’ financial performance.

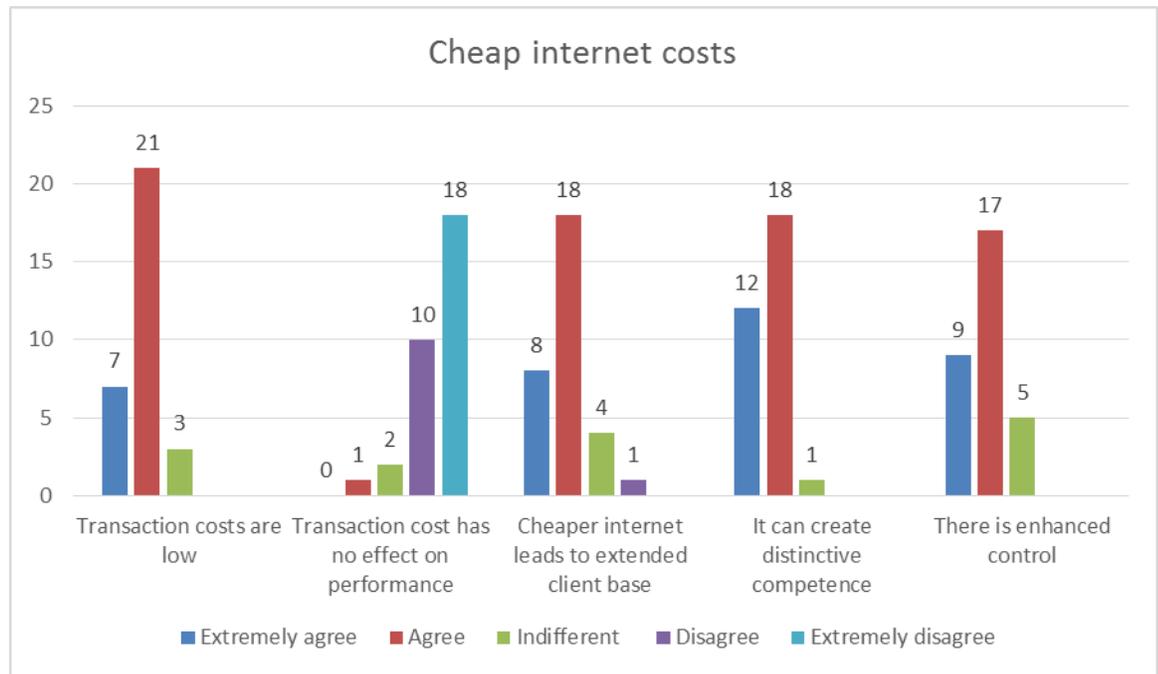


Figure 4.5: How respondents rate cheap internet costs to the banks' financial performance.

On whether internet lowers transaction costs, it can be observed from the findings that majority of the respondents representing 67.7% agree with the statement, while 7 respondents representing 22.6% extremely agree and only 3 respondents representing 9.7% are indifferent with the statement.

On the assumption that transaction cost has no effect on performance, majority of respondents representing 58.1% extremely disagree with the assertion, while 10 respondents depicting 32.3% are indifferent and only 2 respondents representing 6.5% agree to the statement. In a nut shell, transaction costs affects performance.

On whether cheaper internet leads to extended client base, 18 respondents representing 58.1% agree with the statement, while 8 respondents representing 25.8% extremely agree and

only 4 respondents representing 12.9% are indifferent to the statement.

On whether cheaper internet can create distinctive competence, majority of the respondents representing 58.1% of the sampled population agree with the statement, while 12 respondents representing 38.7% extremely agree and only 1 respondent who is indifferent.

On whether internet leads to enhanced control, majority of respondents constituting 54.8% agree, while 9 respondents representing 29.0% extremely agree and 16.1% are indifferent to the statement.

Extent to which KCB has embraced electronic banking

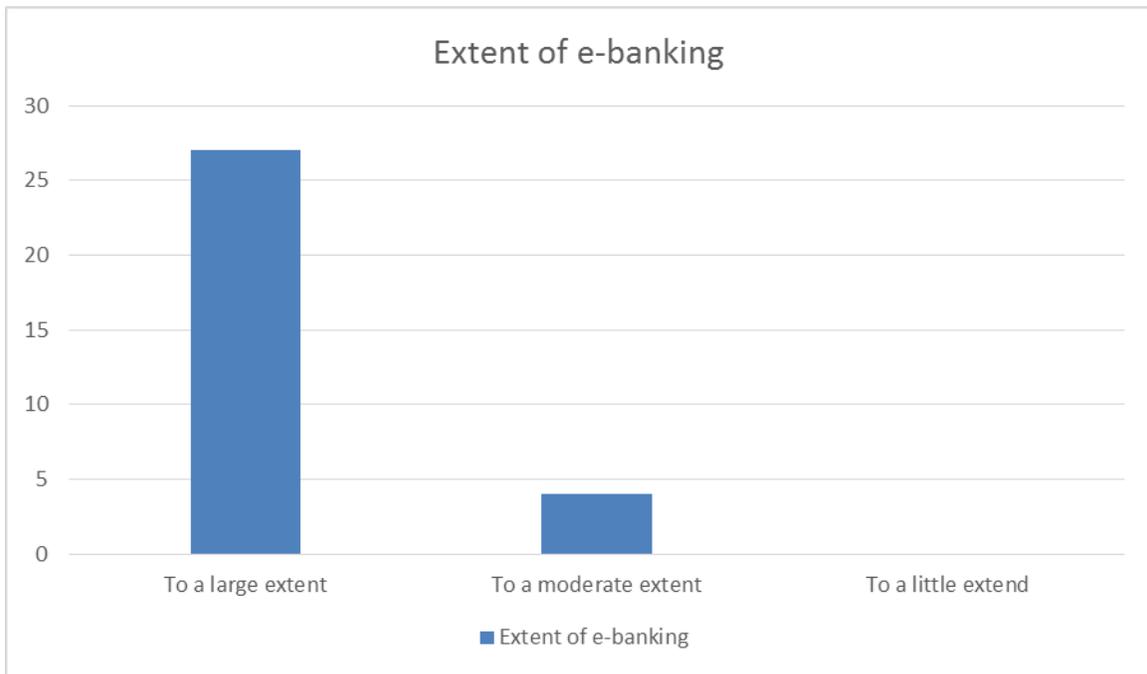


Figure 4.6: Extent to which KCB has embraced e-banking

From the above analysis it can be observed that majority of respondents constituting 87.1% of the sampled population agree that KCB has embraced e-banking in its operations, while only 4

respondents representing 12.9% agree to a moderate extent. This indicates that KCB has entrenched electronic banking in its operations.

Effects of 24hr internet banking on selected variables

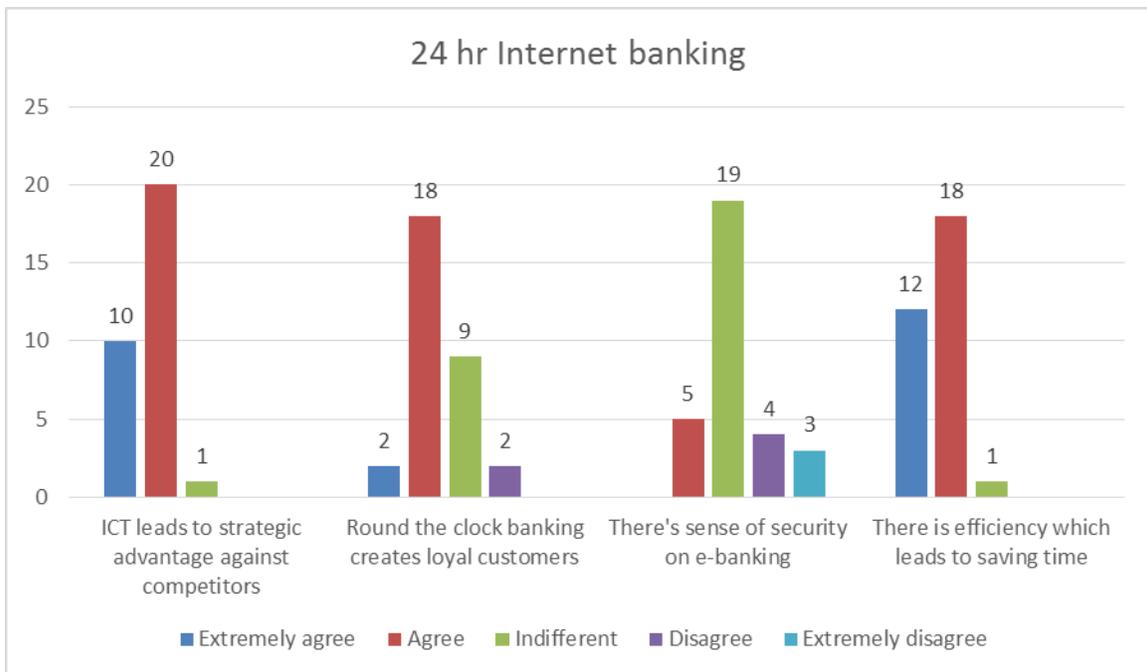


Fig 4.7: Effects of 24hr internet banking

On whether ICT leads to strategic advantage against competitors, it can be observed from the findings that majority of the respondents representing 64.5% agree with the statement, while 10 respondents representing 32.3% extremely agree and

only 1 respondent representing 3.2% are indifferent with the statement.

On the assumption that round the clock banking creates loyal customers, majority of respondents representing 58.1% agree with the assertion, while 9 respondents representing 29.0%

are indifferent and only 2 respondents representing 6.5% disagree and extremely agree to the statement.

On whether customers derive sense of security on e-banking, 19 respondents representing 61.3% agree with the statement, while 5 respondents representing 16.1% extremely agree and only 4 respondents representing 12.9% are indifferent to the statement.

On whether e-banking saves time through efficiency, majority of the respondents representing 58.1% of the sampled

population agree with the statement, while 12 respondents representing 38.7% extremely agree and only 1 respondent who is indifferent.

On whether internet leads to enhanced control, majority of respondents constituting 54.8% agree, while 9 respondents representing 29.0% extremely agree and 16.1% are indifferent to the statement.

ICT competence of customers on financial performance of banks

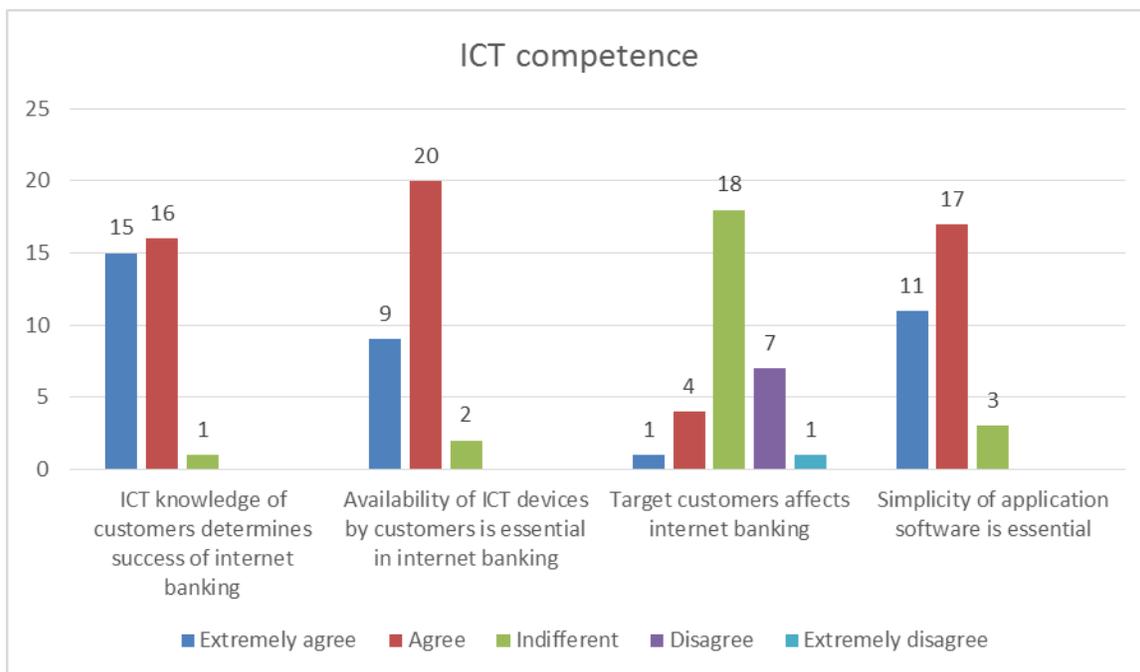


Fig 4.8: ICT competence of customers on banks performance

On whether ICT know how of customers determines success of internet banking, it can be observed from the findings that majority of the respondents representing 51.6% agree with the statement, while 15 respondents representing 48.4% extremely agree and only 1 respondent representing 3.2% are indifferent with the statement.

On the statement that availability of ICT devices by customers is essential in internet banking, majority of respondents representing 64.5% agree with the assertion, while 9 respondents representing 29.0% extremely agree and only 2 respondents representing 6.5% are indifferent.

On whether target customers affects success of internet banking, 18 respondents representing 58.1% are indifferent, while 7 respondents representing 22.6% disagree and only 4 respondents representing 12.9% agree with the statement.

On whether simplicity of application software is essential for the success of internet banking, majority of the respondents representing 54.8% of the sampled population agree with the statement, while 11 respondents representing 35.5% extremely agree and only 3 respondents who are indifferent.

V. SUMMARY OF FINDINGS

The purpose of the study was to establish the effects of internet banking on financial performance of banks; a case study of Kenya Commercial Bank. The objectives of the study were to determine the effect of cheaper internet costs on performance of commercial banks, to establish the effect of 24hr banking on the performance of commercial banks and to find out the effect of customers' ICT competence on performance of commercial banks.

Descriptive research design was used in the study and target population was the employees of KCB Treasury Square branch in Mombasa County. For ethical purpose, an official introductory letter was issued from Jomo Kenyatta University of Agriculture and Technology to request for a permission to carry out the academic research study. To assign meaningful numbers to responses variables were measured at interval scales. Numbers were assigned for responses which were closed ended.

From the study, 61% of the respondents were male and only 39% were female. On the highest level of education, majority (48.4%) of the respondents had degree and 12.9% of the respondents had masters and none had Phd. From the findings, majority of respondents had worked with Kenya Commercial

Bank for more than 6 years. And most of respondents were drawn from finance department and were aged 31 years and 40 years as per the findings.

According to the findings, majority of the respondents representing 67.7% were of the view that the internet lowers transaction costs. Many respondents agreed that there is likelihood of extended client base as a result of internet banking and that internet banking can lead to distinctive competence and enhanced control of banking activities.

On whether KCB has embraced e-banking, majority of the respondents (87.1%) agreed that the bank has fully embraced electronic banking in its operations. Majority of respondents agreed that ICT leads to strategic advantage against competitors and that there is likelihood of customer loyalty due to round-the-clock banking services. On whether customers derive sense of security on e-banking as opposed to over the counter transactions, majority of the respondents comprising of 61.3% agreed to the statement and added that e-banking saves time through efficiency in operations.

On effects of ICT competence of customers, it can be observed from the findings that the ICT know-how of customers determines the success of internet banking. Also majority of respondents comprising 58.1% agreed that the bank's target customers affect success of internet banking and that availability of ICT devices by customers is essential for the success of internet banking. Besides, majority of respondents agreed that success of internet banking is commensurate with simplicity of application software in use.

VI. CONCLUSION

This section was organized in subsection based on the research objectives including: effects of cheaper internet costs on performance of commercial banks; effects of 24hr banking on commercial banks' performance and how customers' ICT competence affects performance of commercial banks.

Effects of cheaper internet costs on banks' performance

From the study it can be found that the reduced internet costs lowers transaction costs which attracts potential customers to the bank. In addition, lower internet costs creates distinctive competence and leads to enhanced control over banking processes. The study reveals that cheaper internet costs can lead to extended client base as many potential customers seek value for their money.

Influence of 24hr banking on banks' performance

With e-banking customers are able to access banks' services round the clock and this creates strategic advantage against competitors hence leading to customers' loyalty and derived sense of security as opposed to over-the-counter banking. Besides, internet banking saves time as a result of increased efficiency.

Effects of customers' ICT competence on commercial banks performance

On ICT competence of customers on performance of banks, the customers' know-how of ICT positively affects success of internet banking, the study established that availability of ICT devices affects the outcome of internet banking and that the simplicity of application software on internet banking platform affects the success of internet banking.

VII. RECOMMENDATIONS

The researcher makes the following recommendations;

Effects of cheaper internet costs on banks performance

The researcher recommends that all the KCB should take advantage of reduced internet costs to lower its transaction costs which in return will attract potential customers hence create customer loyalty. If ICT is effectively used, the bank can create distinctive competence which will enhance its market share.

Effects of 24hr banking on banks performance

The bank should entrench mechanisms to ensure uninterrupted 24hr banking to its clients. This will improve its financial performance.

Effects of customers ICT competence on banks performance

The bank should target those customers who are ICT competent in order to ensure success of internet banking. Besides, KCB should take advantage of reduced costs and wide availability of mobile phones to attract potential customers. The application software used for accessing banks services online should be simple and user friendly so as to be hassle free to the customers.

Suggestion for further Research

The following areas are suggested for further study;

- i. The study should be undertaken under cross-sectional descriptive design which would ensure elimination of any bias experienced in this study.
- ii. A replica of the study should also be carried out within the context of another field other than banking industry for comparative purpose.

REFERENCES

- [1] Accenture (2005). Next Generation Mobile and Internet Banking, Copenhagen.
- [2] Allen, F., Mcandrews, J. and P. Strahan, (2002), E-finance: An Introduction, *Journal of Financial Services Research* 22:1/2 5-27.
- [3] Altunbas, Y., Goddard, J., Molyneux, P., (1999), Technical change in banking. *Economics Letters* 64, 215-221.
- [4] Banks, E. (2001), *E-finance: The Electronic Revolution*: New York: John Wiley & Sons Ltd.
- [5] Basel Committee on Banking Supervision (July 2003). Risk Management Principles for Electronic Banking. Bank for International Settlements.
- [6] Birch, D. and Young, M.A. (1997). Financial Services and the Internet-What does cyberspace mean for the financial services industry? *Internet Research: Electronic Networking Applications and Policy*, 7 (2), pp. 120-128.
- [7] Caprio, Gerard et...al. (2005). Banking Crisis Database in Patrick Honohan and Luc Laeven (eds.), *Systemic Financial Crises: Containment and Resolution*. Cambridge, UK and New York: Cambridge University Press.
- [8] Casu, B., Girardone, C., Molyneux, P., (2004). Productivity change in European banking: A comparison of parametric and non-parametric approaches. *Journal of Banking and Finance* 28, 2521-2540.
- [9] Centeno, C. (2004). Adoption of Internet Services in the Acceding and Candidate Countries, *Lessons from the Internet Banking Case*. *Telematics and Informatics*, 21, pp. 293-315.
- [10] Claessens, S., Glaessner, T. and D. Klingebiel (2001), *E-Finance in Emerging Markets: Is Leapfrogging Possible?*, Financial Sector Discussion Paper No. 7, The World Bank June

- [11] Claessens, S., Glaessner, T. and D. Klingebiel (2002) Electronic Finance: Reshaping the financial landscape around the world, *Journal of Financial Services Research*; Aug/Oct 2002; 22, 1,2
- [12] Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions (2005). i2010 – A European Information Society for growth and employment. Retrieved December 26, 2006, from http://europa.eu.int/information_society/europe/i2010/docs/communication_s/com_229_i2010_310505_fv_en.pdf
- [13] Demircuc-Kunt, Asli and Harry Huizinga. 1999. Determinants of Commercial Bank Interest Margins and Profitability: Some International Evidence. *World Bank Economic Review* 13(2) : 397-408
- [14] Deutsche Bank Research (2005). Five online banking trends in 2005. E-banking snapshot 13.
- [15] Deutsche Bank Research (2006). Online banking: What we learn from the differences in Europe. E-banking snapshot 16.
- [16] DeYoung, R., Lang, W.W. and Nolle, D.L., (2007), How the Internet affects output and performance at community banks, *Journal of Banking & Finance* 31 1033–1060
- [17] DeYoung, R. (2005). The performance of Internet-based business models: Evidence from the banking industry. *Journal of Business* 78 (3), 893–947.
- [18] Europe 2002 Action Plan (2000). Retrieved December 23, 2006, from http://europa.eu.int/information_society/europe/2002/action_plan/pdf/actionplan_en.pdf
- [19] Furst, K., Lang, W.W. and D.E. Nolle (2002) Internet Banking, *Journal of Financial Services Research*, 22:1/2 95-117.
- [20] Goddard, J., Molyneux, P., Wilson, J.O.S. and M. Tavakoli, (2007) European banking: An overview, *Journal of Banking & Finance* 31 1911–1935
- [21] Gurau, C. (2002). Online Banking in Transition Economies: The Implementation and Development of Online Banking Systems in Romania. *International Journal of Bank Marketing*, 20/6, pp. 285-296
- [22] Hernando, I., Nieto, M.J. (2007), Is the Internet delivery channel changing banks' performance? The case of Spanish banks, *Journal of Banking & Finance* 31 1083–1099
- [23] Jayawardhena, C. and P. Foley (2000), Changes in the banking Sector: the case of Internet banking in the UK, *Internet Research: Electronic Networking Applications and Policy* Volume 10 .
- [24] KPMG (1999). Internet Financial Services Survey. Official Journal, 2006. Information Society Strategy (2006-2010), RG26242, 28.07.2006.
- [25] Quispe-Agnoli, Myriam and Elena Whisler. 2006. Official Dollarization and the Banking System in Ecuador and El Salvador. *Economic Review* 91 (3): 55-71.
- [26] Romero-Avila, D. (2007), Finance and growth in the EU: New evidence from the harmonisation of the banking industry, *Journal of Banking & Finance* 31 1937–1954
- [27] Simpson, J. (2002). The Impact of the Internet in Banking: Observations and Evidence from Developed and Emerging Markets. *Telematics and Informatics*, 19, pp. 315-330.
- [28] Sullivan, Richard J., (2000). How has the adoption of Internet banking affected performance and risk at banks? A look at Internet banking in the tenth federal reserve district, "Federal reserve bank of Kansas City. *Financial Industry Perspectives* (December), 1–16.
- [29] Wright, A. (2002). The Changing Competitive Landscape of Retail Banking in the E-commerce Age. *Thunderbird International Business Review*, Vol. 44 (1), pp. 71-84.

AUTHORS

First Author – Stephanie Kadzo Kombe, Revenue Accountant
Kenya Power LTD, P.O. Box 920104-80100, Mombasa
Second Author – Moses Kimani Wafula, Senior Assistant
Librarian, Jomo Kenyatta University of Agriculture and
Technology Mombasa CBD, 81310-80100-Mombasa, Kenya

A Real Time Two Hand Gesture Recognition System Using Motion Static and Dynamic Image in British Sign Language

Pingale Prerna Rambhau *, Prof.Rokade S.M**

* Department of Computer Engineering, Sir Vishaveshwaray Institute Technology, Chincholi, Tal-Sinner,Dist- Nashik ,India

** Head, Computer Engineering Department, Sir Vishaveshwaray Institute Technology, Chincholi, Tal-Sinner,Dist- Nashik ,India

Abstract- The introduce of finger spelling two hand gesture with the real time stereo vision hand tracking for implementation and analysis, used for interaction purpose. Many researchers have proposed methods that hand posture estimation. We have propose on two hand gesture recognition system using real time video image, the hand of fingers is extracting using contour with its features like finger shape with static and dynamic image, motion hand etc. The input of the system as BSL finger spelling which is recognition by using contour analysis and extraction. The experimental performance of system is tested in real time hand tracking world, which present results around 60% recognition rate efficiency.

Index Terms- Finger Spelling, hand posture estimation, static and dynamic image.

I. INTRODUCTION

The system can track the 2D position and 3D position index finger gestures of two hands without the use of gloves or any type special markers. In world, some people is ‘deaf with handicapped’, like someone who is blind, they cannot ride a bike, can’t drive a car, do not go to work, shop, and can’t go on vacation like everybody else. The major problem for deaf and dumb peoples is “Communication”. The objective to help the deaf and dump people or non vocal persons to improve the skills on communication between non vocal person and normal person and bring them in flow of society [2].

The system has four parts which is: 1) hand segmentation: from image sequences to segment the region of the hand , 2) key hand posture selection: From image sequence to determine the key frame which representing the hand posture of Finger-spelling symbols, 3) hand feature definition: to define the finger shapes symbol and hand features as contour extraction sequence, 4) finger-spelling recognition, to recognize the finger-spelling from hand features from real time image sequences[1].

II. RELATED WORK

A. Literature Survey

To summarize, the previous works on finger-spelling recognition, In [1] Kittasil Silanon, Nikom Suvonvorn, its features, such as, finger shape, and hand appearance, had been defined as chain code, which are input to the American finger-spelling recognition system by using a vote method. The

performance of the system is tested in real-time environment, which results in around 70% recognition rate. In [3] K. Otiniano Rodrguez, G. Camara-Chavez, design to hybrid system approach for finger spelling recognition using RGB-D information from KinectTM sensor and its approach has anaccuracy rate of 91.26% when RGB and depth information is used, outperforming other state-of-the-art methods. In [4] Md. Atiqur Rahman, presents a system for recognizing static hand gestures of alphabet in Bangla Sign Language (BSL). A BSL finger spelling and an alphabet gesture recognition system was designed with Artificial Neural Network (ANN) and constructed in order to translate the BSL alphabet into the corresponding printed Bangla letters. In [5] Nicolas Pugeault and Richard Bowden, presents an interactive hand shape recognition user interface for American Sign Language (ASL) finger-spelling.In [6] Dominique Uebersax, Juergen Gall, Michael Van den Bergh, Luc Van Gool, BIWI, ETH Zurich 2ESAT-PSI / IBBT, KU Leuven, present a system for recognizing letters and finger-spelled words of the American sign language (ASL) in real-time. See in [7] [8], report results on a dataset of 1,000 low quality webcam videos of 100 words. The proposed method achieves a word recognition accuracy of 98.9%. In [9] Paul Goh, presents the Auslan Finger-spelling Recognizer (AFR) that is a real-time system capable of recognizing signs that consists of Auslan manual alphabet letters from video sequences.

B. Implementation Details

1. Overview of Emgu CV: Emgu CV is a cross platform .Net wrapper to the OpenCV image processing library. Allowing OpenCV functions to be called from .NET compatible languages such as C#, VB, VC++, IronPython etc. The wrapper can be compiled in Mono and run on Windows, Linux, Mac OS X, iPhone, iPad and Android devices.

2. Overview of Emgu CV Versions:

Name	Emgu CV (Open Source)	Emgu CV (Commercial Optimized)	Emgu CV for iOS (Commercial)	Emgu CV for Android (Beta)
OS	Windows, Linux, Mac OSX	Windows	iOS (iPhone, iPad, iPod Touch)	Android
Supported CPU Architecture	i386, x64	i386, x64	armeabi, armeabi-v7, i386 (Simulator)	armeabi, armeabi-v7s, x86
GPU Processing	✓	✓	X	X
Machine Learning	✓	✓	✓	✓
Tesseract OCR #	✓	✓	✓	✓
Intel TBB # (multi-thread)	X	✓	X	X
Intel IPP # (high performance)	X	✓	X	X
Intel C++ Compiler # (fast code)	X	✓	X	X
Exception Handling	✓	✓	✓	✓
Debugger Visualizer	✓	✓	X	X
Emgu.CVM	✓	✓	X	X
License	GPL	Commercial License	Commercial License	Commercial License

Fig.1. Overview of Emgu CV Versions

3. Advantage of Emgu CV

- Cross Platform
- Image class with Generic Color and Depth
- Automatic garbage collection
- XML Serializable Image
- XML Documentation and intellisense support
- The choice to either use the Image class or direct invoke functions from OpenCV

4. Architecture Overview

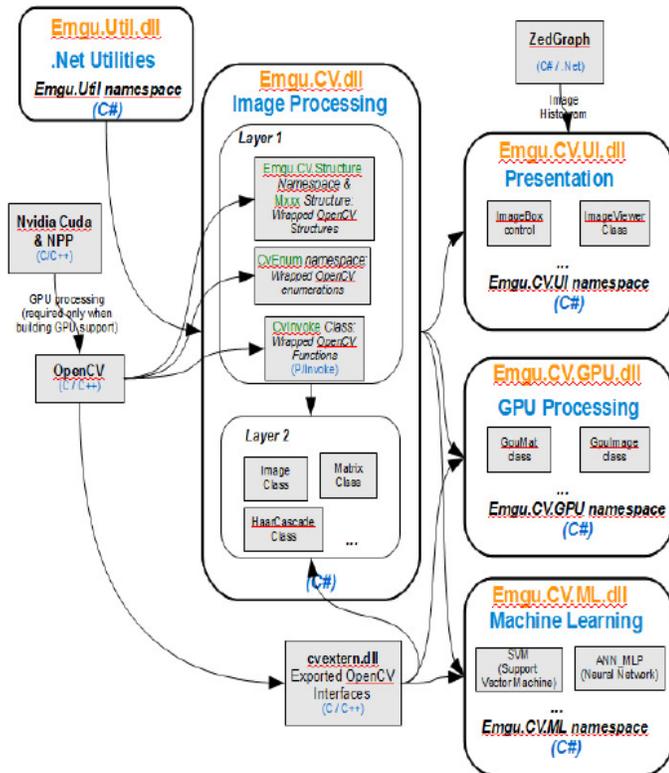


Fig.2. Architecture of EmguCV

Emgu CV has two layers of wrapper as shown above Fig.2

- The basic layer (layer 1) contains function, structure and enumeration mappings which directly reflect those in OpenCV.
- The second layer (layer 2) contains classes that mix in advantages from the .NET world.

5. Wrapping OpenCV

I. Function Mapping - Emgu.CV.CvInvoke: The CvInvoke class provides a way to directly invoke OpenCV function within .NET languages. Each method in this class corresponds to a function in OpenCV of the same name. For example, a call to:

```
IntPtr image = CvInvoke.cvCreateImage(new System.Drawing.Size(400, 300), CvEnum.IPL_DEPTH_IPL_DEPTH_8U, 1);
```

is equivalent to the following function call in C

```
IplImage* image=cvCreateImage(cvSize(400,300), IPL_DEPTH_8U, 1);
```

Both of which create a 400x300 of 8-bit unsigned grayscale image.

II. Structure Mapping - Emgu.CV.Structure.Mxxx: This type of structure is a direct mapping to OpenCV structures.

III. Enumeration Mapping - Emgu.CV.CvEnum: The CvEnum namespace provides direct mapping to OpenCV enumerations. For example,

CvEnum.IPL_DEPTH_IPL_DEPTH_8U has the same value as *IPL_DEPTH_8U* in OpenCV; both of which equals 8.

6. Depth and Color as Generic Parameter:

An Image is defined by its generic parameters: **color** and **depth**. To create a 8bit unsigned Grayscale image, in Emgu CV it is done by calling

```
Image<Gray, Byte> image = new Image<Gray, Byte>( width, height);
```

Not only this syntax make you aware the color and the depth of the image, it also restrict the way you use functions and capture errors in compile time. For example, the SetValue(TColor color, Image<Gray,Byte> mask) function in Image<TColor, TDepth> class (version >= 1.2.2.0) will only accept colors of the same type, and mask has to be an 8-bit unsigned grayscale image. Any attempts to use a 16-bit floating point or non-grayscale image as a mask will results a compile time error!

7. Creating Image:

Although it is possible to create image by calling CvInvoke.cvCreateImage, it is suggested to construct a Image<TColor, TDepth> object instead. There are several advantages using the managed Image<TColor,TDepth> class.

- Memory is automatically released by the garbage collector
- Image<TColor, TDepth> class can be examined by Debugger Visualizer
- Image<TColor, TDepth> class contains advanced method that is not available on OpenCV, for example, generic operation on image pixels, conversion to Bitmap etc.

I. Image Color:

The first generic parameter of the Image class specific the color of the image type. For example

```
Image<Gray, ...> img1;
```

indicates that img1 is a single channel grayscale image.

Color Types supported include:

- Gray
- Bgr (Blue Green Red)
- Bgra (Blue Green Red Alpha)
- Hsv (Hue Saturation Value)
- Hls (Hue Lightness Saturation)
- Lab (CIE L*a*b*)
- Luv (CIE L*u*v*)
- Xyz (CIE XYZ.Rec 709 with D65 white point)
- Ycc (YCrCb JPEG)

II. Image Depth:

Image Depth is specified using the second generic parameter Depth. The types of depth supported in Emgu CV 1.4.0.0 include

- Byte
- SByte
- Single (float)
- Double
- UInt16
- Int16
- Int32 (int)

a. Creating a new image:

To create an 480x320 image of Bgr color and 8-bit unsigned depth. The code in C# would be

```
Image<Bgr, Byte> img1 = new Image<Bgr, Byte>(480, 320);
```

If you want to specify the background value of the image, let's say in Blue. The code in C# would be

```
Image<Bgr, Byte> img1 = new Image<Bgr, Byte>(480, 320, new Bgr(255, 0, 0));
```

b. Reading image from file:

Creating image from file is also simple. If the image file is "MyImage.jpg", in C# it is

```
Image<Bgr, Byte> img1 = new Image<Bgr, Byte>("MyImage.jpg");
```

c. Creating image from Bitmap

It is also possible to create an Image<TColor, TDepth> from a .Net Bitmap object. The code in C# would be

```
Image<Bgr, Byte> img = new Image<Bgr, Byte>(bmp); //where bmp is a Bitmap
```

8. Methods:

Naming Convention

- Method XYZ in Image<TColor, TDepth> class corresponds to the OpenCV function cvXYZ. For example,

```
Image<TColor, TDepth>.Not()
```

function corresponds to cvNot function with the resulting image being returned.

- Method _XYZ is usually the same as Method XYZ except that the operation is performed inplace rather than returning a value. For example,

```
Image<TColor, TDepth>._Not()
```

function performs the bit-wise inversion inplace.

9. Drawing Objects on Image:

The Draw() method in Image<Color, Depth> can be used to draw different types of objects, including fonts, lines, circles, rectangles, boxes, ellipses as well as contours. Use the documentation and intellisense as a guideline to discover the many functionality of the Draw function.

10. Color and Depth Conversion:

Converting an Image<TColor, TDepth> between different colors and depths are simple. For example, if you have Image<Bgr, Byte> img1 and you want to convert it to a

grayscale image of Single, all you need to do is `Image<Gray, Single> img2 = img1.Convert<Gray, Single>();`

11. Displaying Image:

Using ImageBox:

Emgu CV recommends the use of ImageBox control for display purpose, for the following reasons:

- ImageBox is a high performance control for displaying image. Whenever possible, it displays a Bitmap that shares memory with the Image object, therefore no memory copy is needed (very fast).
- The user will be able to examine the image pixel values, video frame rates, color types when the image is being displayed.
- It is convenient to perform simple image operations with just a few mouse clicks.

III. MATHEMATICAL MODEL

Problem Definition:

The real time input image is processed in order to identify pixels that depict human hands.

Let A be a user ;such that $A = \{U, S, H, M, L, C, T\} \cap \Phi_a$ where U represent the set of all pixels of an image; $U = \{u_1, u_2, \dots, u_n\}$; M be the subset of U Corresponding to foreground pixels where to identify a human body such that $M = \{m_1, m_2, \dots, m_n\}$; and S be the subset of U containing pixels that are skin colored. And H stand for the sets of pixels that depict human hands. The relations between the above mentioned sets are illustrated in the Venn diagram shown in Fig. 6. The implicit assumption in the above formulation is that H is a subset of M, i.e. hands always belong to the foreground.

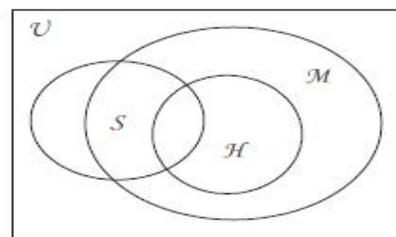


Fig. 3 Venn diagram representing the relationship between the pixel sets U, M, S and H.

Activity1

Let fs be a rule of S and H into U such as H be binary random variables (i.e taking values in 0,1), indicating whether a pixel belongs to S and H, such as:

$$\{s_1, s_2, \dots, s_n\} \rightarrow \{h_1, h_2, \dots, h_n\} \in U$$

Activity2

let M be a binary variable (determined by the employed foreground subtraction algorithm) that indicates whether a pixel belongs to M such as:

$$\{s_1, s_2, \dots, s_n\} \in M$$

Activity3

Let L be the 2D location vector containing the pixel image coordinates and let T be a variable that encodes a set of features regarding the currently tracked hypotheses such as $(l_1, l_2, \dots, l_n) \rightarrow \{t_1, t_2, \dots, t_n\} \in U$

Activity4

Given all the above, the goal of processing is to compute whether a pixel belongs to a hand, given

- (a) the color c of a single pixel,
- (b) the information m on whether this pixel belongs to the background (i.e. $M = m$) and, (c) the values l and t of L and T , respectively. Specify, the conditional probability:

$$P(h) = P(H=1; C=c; T=t; L=l M=m)$$

To perform this estimation to finding contour compression nodes $\{S_0, S_1, S_2, S_3, S_4, S_5\}$ in the correspond to random variables that represent degrees of belief on particular aspects of the problem. The edges in the graph are parameterized by conditional probability distributions that represent causal dependencies between the involved variables.

Efficiency factor:

- S0: Foreground pixel(M)
- S1: Pixel Location (L)
- S2: Skin colored Object (S)
- S3: Hand Pixel (H)
- S4: Perceived Color(C)
- S5: Top-Down Information (T)

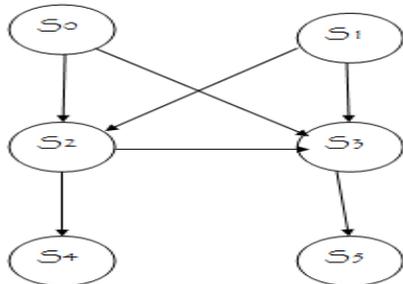


Fig. 4 Proposed Factors relationship

State Diagram:

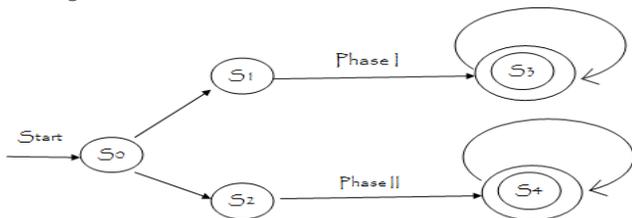


Fig. 5. State diagram for whole system

- S0: Start System
- S1: Enter in Phase I(Sign to text conversion)
- S2: Enter in Phase II(Text to sign conversion)
- S3: Output of Phase I
- S4: Output of Phase II

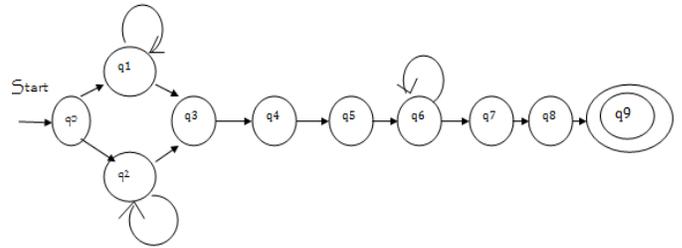


Fig. 6. State diagram for phase I system

- q0: Start System
- q1: Web Initialization (Web camera using USB)
- q2: Web Initialization (laptop camera)
- q3: Capture image
- q4: Skin color extraction
- q5: Hand segmentation
- q6: Mapping of image to corresponding alphabets
- q7: Construct sentence
- q8: Show output text
- q9: speech conversion

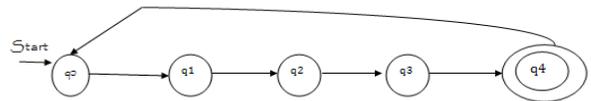


Fig. 7. State diagram for phase II system

- q0: Start system
- q1: Provide sentence to the computer
- q2: word, alphabet separation
- q3: Mapping of Character to each image
- q4: Show the images on system

IV. RESULT ANALYSIS

Phase II: Text to sign conversion



Fig. 8 Phase II:Text to sign conversion

In this sentences are scanned entered by user and then alphabets separation module separate the alphabets from sentences and corresponding image is display to viewers.

Phase I: sign to text conversion

Sign processing phase is the result of methods describe above that frame grabber, hull drawing, contour extraction and sign mapping. In output screen it display two sections first section displays input from user and second section displays binary images of capture image. At the bellow side It displays the text generated and button for speech conversion. In order to verify the efficiency of the proposed gesture recognition algorithm, an Intel Core with an USB camera is used in this experiment, and the program is coding under OpenCV.

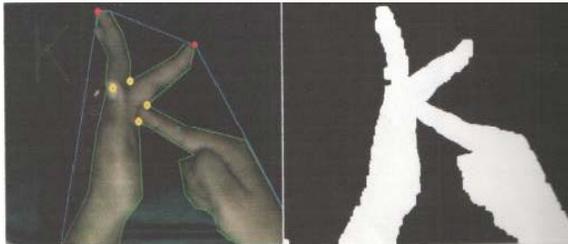


Fig. 9 Phase I: sign to text conversion

V. EXPERIMENTAL RESULTS

In this section we represent the recognition results on Real Time Two Hand Gesture Recognition System Using Motion Static and Dynamic Image in British Sign Language.

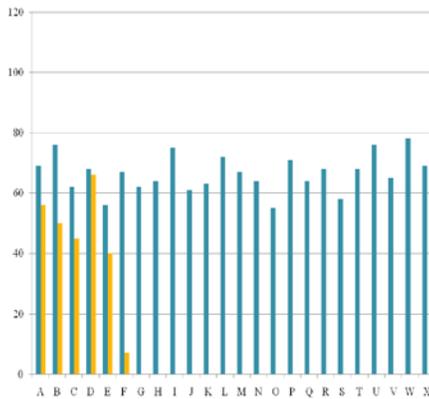


Fig.10 Experimental Results

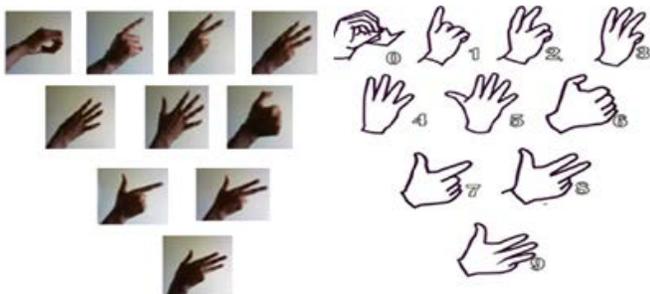


Fig.11 Database of 0 to 9 numbers and Preprocessing results

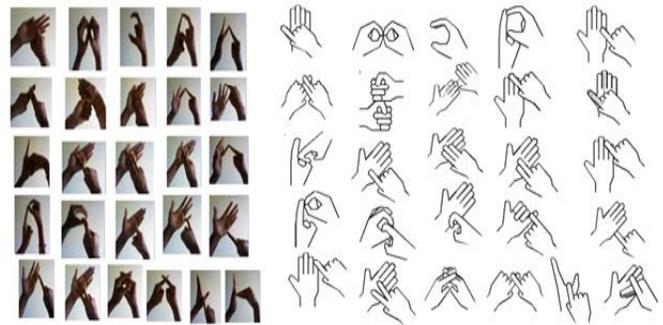


Fig.12 Database of 26 sign alphabets and Preprocessing results

VI. CONCLUSION

In this paper, present a simple model of static and dynamic gestures of British Sign Language alphabet recognition system, does not require any special markers or The motivation for this hand tracker was a desktop-based two-handed interaction system in which a user can select and manipulate geometric in real time using natural hand motions. And finally with the help of this software communication barrier and dumb people and normal people get reduced.

ACKNOWLEDGMENT

We would like to express our sincere thanks and deep sense of gratitude to personnel who helped us during collection of data and give us their rare and valuable guidance for the preparation presentation of the report. We express our grateful acknowledgement to Prof.S.M.Rokade for giving us kind guidance inspiration to complete this report. We extend our sincere thanks to the Prof.S.M.Rokade Head of Computer Engineering Department. We also express our gratitude to our parents for their encouragement While concluding this acknowledgement we also express our sincere thanks to our friends, well wishers, our colleagues, staff members of SVIT,chincholi who extended their kind cooperation to complete this report.

REFERENCES

- [1] Kittasil Silanon,Nikom Suvonvorn,"Finger- Spelling Recognition System using Fuzzy Finger Shape and Hand Appearance Features",ISBN: 978-1-4799-3724-0/14/\$31.00 2014 IEEE.
- [2] Pingale Perna Rambhau."Recognition of Two Hand Gestures of word in British Sign Language (BSL)".International Journal of Scientific and Research Publications,Volume 3, Issue 10, October 2013 ISSN 2250-3153.
- [3] Stephan Liwicki, Mark Everingham, Automatic Recognition of Finger spelled Words in BritishSign Language, in Proc. IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops, pp. 50-57, Miami, FL, USA, June, 2009.
- [4] R. Feris, M. Turk, R. Raskar, K. Tan, and G. Ohashi. Exploiting depth discontinuities for vision-based fingerspelling recognition. In In IEEE Workshop on Real-time Vision for Human-Computer Interaction, 2004.
- [5] X.D. Huang, Y. Ariki, and M. A. Jack. Hidden Markov Models for Speech Recognition. Edinburgh University Press, 1990.
- [6] L. R. Rabiner. A tutorial on hidden Markov models And selected applications in speech recognition. Proc. IEEE, 77:257286, 1989/, 2011.

- [7] M. Jones and J. Rehg. Statistical color models with application to skin detection. IJCV, 46(1):8196, 2002.
- [8] J. Schlenzig, E. Hunter, and R. Jain. Recursive identification of gesture inputs using hidden Markov models. Proc. Second Annual Conference on Applications of Computer Vision, pages 187 194, December 1994.
- [9] D. B. Nguyen, S. Enokida, and E. Toshiaki, Real-Time Hand Tracking and Gesture Recognition System, IGVIP05 Conference, CICC, pp. 362-368, 2005.

Pune), Sir Vishaveshwaray Institute Technology, Chincholi, Tal-Sinner, Dist- Nashik ,India, Email Id:

pingale.prerna795@gmail.com

Second Author- Prof.Rokade S.M. Head,Computer Engineering Department, Sir Vishaveshwaray Institute Technology, Chincholi, Tal-Sinner,Dist- Nashik ,India, Email Id: smrokade@yahoo.com

AUTHORS

First Author – Pingale Prerna Rambhau, ME Second Year Student,Department of Computer Engineering(University of

Post Exposure Passive Immunization with Purified Equine Rabies Immunoglobulins – Is Skin Sensitivity Test Needed?

Dr.Sunitha B*, Dr.A Madhav**, Dr.Meera M***

*Civil Assistant Surgeon, Department of Pediatrics, SRRIT&CD, Osmania Medical College, Hyderabad, Telangana State.

**Assistant Professor of Medicine, Department of General Medicine, SRRIT&CD, Osmania Medical College, Hyderabad, Telangana State.

***Professor of Microbiology, Department of Microbiology, SRRIT&CD, Osmania Medical College, Hyderabad, Telangana State.

Abstract

Background: Passive post exposure prophylaxis for rabies is life saving. Equine rabies immunoglobulins (ERIG) are readily available and much cheaper compared to human rabies immunoglobulins (HRIG). Not only several studies conducted across the globe to assess the impact of Skin sensitivity test (SST) but also WHO recommend that, ERIG needs to be administered mandatorily irrespective of SST result. An effort was made in the present study to have hands on experience regarding the usefulness of SST before administering purified ERIG.

Materials and Methods: The present study involves 2528 patients who presented with animal bite wounds in the emergency ward of an infectious diseases hospital for anti rabies post exposure prophylaxis, from 1st August to 31st October 2014. Skin sensitivity test with 0.1ml of 1 in 10 dilutions of ERIG (as per the recommendations of product insert of the company i.e., Bharat serums and vaccines limited, Mumbai / VINS bio products, Andhra Pradesh) was performed for all patients.

Results: Sixty out of 2528 patients (2.37%-p value 0.02) showed positive skin test.

Twenty seven out of 60 (45%) did not show positive reaction to repeat SST and received full dose without any adverse effects. Seventeen, who could not afford HRIG, received ERIG along with pheniramine maleate and hydrocortisone as premedication with no adverse effects.

Six patients were administered HRIG, while 10 patients refused for any treatment.

5 patients who showed no reaction to SST developed adverse effects on full dose administration in the form of seizures, giddiness, vomiting, rash and itching.

Conclusion: Since Skin sensitivity test does not represent systemic hypersensitivity, ERIG can be administered for those patients who cannot afford HRIG, with extreme caution & preparedness to deal with any untoward reactions.

Index Terms: Post exposure prophylaxis, Equine rabies immunoglobulin, Human rabies immunoglobulin, Skin sensitivity test.

I. INTRODUCTION

Lack of political commitment and low socio economic conditions have led to regular reporting of rabid dog bites across India which is now one among the rabies endemic countries. Apart from wound management, one of the most important aspects of prevention of rabies is passive prophylaxis in the form of immunoglobulins, to destroy the virus as early as possible. Most of the victims belong to low socio economic group who cannot afford Human rabies immunoglobulins. Equine rabies immunoglobulins, which are cheap and easily available in the market, carry a small risk of anaphylactic reactions which is why Skin sensitivity test is routinely performed to ensure safety of its administration. While this was true of the earlier crude ERIG, the present preparation marketed by reputed companies are products of indigenous technologies and proven to be much safer with minimum risk of sensitivity (0.8%). Moreover, WHO recommends against the tedious and time consuming SST which may delay the preventive management of a fatal condition, Rabies.

II. MATERIALS AND METHODS

The study involving 2528 patients presenting to outpatient department of an infectious diseases hospital with animal bite wounds was conducted from 1st August to 31st October 2014. All patients of category III animal bite wounds were included in the study. Detailed history of past illnesses and co morbid conditions like diabetes, epilepsy, hypertension, asthma were noted. Known hypersensitivity to drugs /serum products received in the past was also noted.

The wounds were thoroughly washed with soap water as an immediate therapeutic measure. Meanwhile the dose of equine rabies immunoglobulin at 40 IU per Kg to be administered for each patient would be calculated. Two different brands of ERIG with same composition and strength i.e., Equirab, marketed by Bharat serums and vaccines limited, Mumbai and Vinrig of VINS bio products, Andhrapradesh were used subjected to availability. For SST, 1 ml of ERIG, mixed with 9 ml of sterile normal saline, 0.1 ml of this 1 in 10 dilutions taken in an insulin syringe and injected intra dermally into the flexor aspect of left forearm, raising a wheal 5 to 6 mm size. The patient was kept under observation with frequent recording of pulse, blood pressure and respiratory rate for the next 30 minutes. The test

was considered positive if there was erythema and/or induration of more than 10 mm at the test site or any other systemic reaction in the form of itching, vomiting, giddiness, and rash. The test was considered negative when there was no change at the test site.

All patients who tested positive for the skin test were given a second test dose to rule out any errors relating to method of administration or interpretation of the test. When the second test showed no reaction, it was considered truly negative and ERIG was given without any premedication.

If repeat SST was positive, patients were advised HRIG and for those who could not afford, ERIG was given after premedication with intramuscular pheniramine maleate and hydrocortisone.

III. RESULTS

Out of 2528 patients, 688 (27.2%) were in 0-12 yrs age group, 1177(46.5%) were in 12-40yrs age group, 506 (20%) were in 41-60yrs age group and 157 (6.2%) were in >60 yrs age group. (Table 1)

One thousand eight hundred and eighteen (71.9%) were males and 710 (28%) were females. (Table 1)

Two thousand four hundred and twenty two (95.8%) were dog bites, and while remaining were cat (37), monkey(58), wild rat(5), pig(5), bat(1) (Table 2).

All patients belonged to category III wounds.

Two thousand three hundred and five (91%) patients reported washing the wounds with soap, water and antiseptics at home. (Table 3).

SST was negative in 2468 (97.6%) patients and received complete dose of ERIG, maximum in filtered locally into the wounds and rest intramuscularly into the gluteal muscle. 5 patients who had negative SST showed certain adverse effects during administration of full dose of ERIG.

- Seizures in a known case of epilepsy
- One patient had vomiting
- One patient had rash and itching all over the body
- Two patients complained of giddiness

All 5 patients recovered with symptomatic management.

Sixty patients (2.37%) had wheal and flair reaction to the skin test initially out of whom 27 (45%) did not show positive reaction on repetition of the test. All 27 patients were given full dose of ERIG without any adverse effects

Though the remaining 33 patients were advised HRIG, only 6 patients could afford it.

Ten patients did not give consent to any form of treatment while 17 patients who could not afford HRIG were given injection pheniramine maleate and hydrocortisone and then the full dose of ERIG; no adverse reactions were noticed in these cases (Figure 1).

IV. DISCUSSION

Rabies is an important zoonotic infection which if not prevented results in 100% mortality. Post exposure prophylaxis in the form of Immunoglobulin is life saving especially in category III wounds. The present study was taken up at an institute approached by all animal bite victims for wound

management and anti rabies vaccine from all over the state. Most of them happen to be from poor socio economic background and cannot afford HRIG. Moreover, by the time they reach the hospital, valuable time gets lost in transit and the wound management needs to be done immediately.

In regards to skin sensitivity test (SST), the report of WHO consultation on intra dermal application of human rabies vaccine (1995) ¹ clearly states that SST should no longer be used for ERIG, since it neither predicts anaphylaxis nor serum sickness; ERIG can be given directly with preparedness to meet any untoward effects, should they occur. In those patients in whom SST is done and is positive, even then the attending physician has to proceed with ERIG, in case HRIG cannot be purchased, with special precautions like pretreatment with anti histamine, steroids and adrenalin and patient kept under observation for at least 1 hour after full dose administration.² Several studies conducted at various centers across the country confirm WHO observation that reactogenicity following purified ERIG administration is minimal, since the equine serum, rich in immunoglobulins gets subjected to heat treatment, pepsin digestion and enzyme refinement with very low protein content³. Moreover ERIG is indigenously manufactured in the country unlike HRIG, which is imported from Italy. ERIG is suitable for low socio economic group of patients who constitute the majority of animal bite victims at the present study centre.

Men, in the age group 12 to 40 yrs being active and most ambulant were most commonly affected.

Dogs, as in any other study, were found to be the most offending animal in the present study. The other animals involved were monkey, cat, wild rat, pig, and bat.

The status of animals was mostly unknown, an observation that made it imperative to initiate post exposure prophylaxis as early as possible with readily available ERIG, SST was still performed for all patients and ERIG was administered in appropriate dosage for those with no reaction.

Local reaction with heterologous serum like ERIG, which is immediate and IgE mediated, does not detect systemic reactions, triggered by complement and /or mast cell activation. Hence, the attending medical staff was always ready with adrenaline loaded syringes, antihistamines and steroids to deal with emergency situations. This happened in 5 (0.19%) patients with negative SST. One patient, a known case of epilepsy, developed seizures during ERIG administration; the other 4 suffered from giddiness, vomiting, rash and itching and recovered with symptomatic treatment.

SST was repeated for all 60 patients who showed positive reaction because of a lurking premonition on the part of attending medical team that made them to decide to repeat the test since they wanted to rule out technical and interpretation errors.

Twenty seven patients did not show positive reaction to repeat SST and received full dose of ERIG without any adverse effects, not even in the minimalistic form sooner or later.

Thirty three, who showed positive reaction after repeat SST, would have any way received only ERIG owing to financial constraints since all belonged to low socio economic group except 6 patients who opted for HRIG.

Ten patients who showed positive reaction to repeat SST, in the three month period, randomly, for reasons unknown, in spite

of perseverance of the medical team, did not consent to any form of treatment and left against medical advice.

Seventeen patients who were willing to receive ERIG along with premedication were administered full dose without any adverse effects. Premedication helps in preventing or attenuating possible immediate reactions, especially steroids which act as anti-inflammatory agents, inhibiting the late manifestations of anaphylaxis, reducing continued release of inflammatory mediators, complement activation while having no immunosuppressive effect in the dosage that is administered⁴.

V. CONCLUSIONS

The present study observed statistically insignificant percentage of (2.37%-p value <0.05) local reactions to SST with minimal systemic adverse effects. The study favors the WHO recommendation that SST is not mandatory for passive anti rabies prophylaxis with equine rabies immunoglobulins. Whenever possible HRIG is to be preferred for affordable patients: however ERIG can be administered without SST for those patients who cannot afford HRIG, with extreme caution and preparedness to deal with any untoward reactions.

Table: 1 showing Age and Gender distribution.

	0-12 yrs	13-40 yrs	41-60 yrs	>60 yrs	Total
Male	497	869	342	110	1818
Female	191	308	164	47	710
Total	688	1177	506	157	2528

Table: 2 showing details of animals involved in bites.

Animals	Total
Dog	2422
Cat	37
Monkey	58
Wild Rat	5
Pig	5
Bat	1
Total	2528

Table: 3 details of first aid measures.

Washed with soap / Antiseptic	2305
Washed with water only	17
Used home remedies	16
Not washed	190
Total	2528

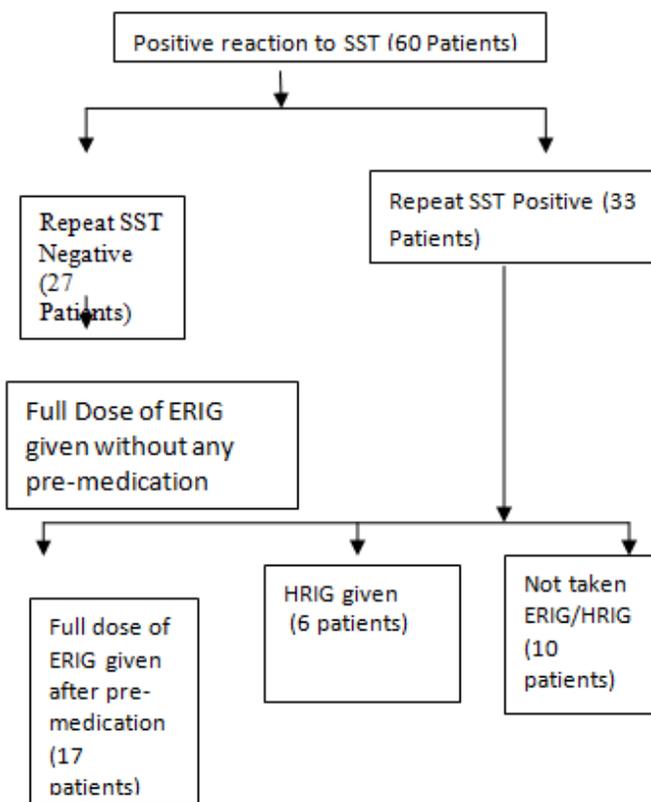


Figure 1: Diagrammatic representation of the Study

ACKNOWLEDGMENT

The authors acknowledge the contribution of Nursing and Technical staff of SRRIT&CD.

REFERENCES

- [1] Report of a WHO consultation on intradermal application of human rabies vaccines – March 13, 1995, Geneva, World health organization.
- [2] WHO - recommendations on rabies post exposure treatment and the correct technique of intradermal immunization against rabies, Geneva, World health organization, 1997.
- [3] Evaluation of safety and efficacy of a new indigenous equine rabies immunoglobulin: Sudarshan MK, Mahindra. BJ, J Assoc Prev Control Rabies, India, 2006; 8: 13-16.
- [4] Cupo P, de-Azevedo-Marques MM, Sarti W, Hering SE, proposal of abolition of skin sensitivity test before equine rabies immunoglobulin application. Rev Inst Med Trop Sao Paulo 2001; 43:51-3

AUTHORS

First Author – Sunitha B, M.D. (Paed), Sir Ronald Ross Institute of Tropical & Communicable Diseases (SRRIT&CD)/ Govt. Fever Hospital, Osmania Medical College, Hyderabad, Telangana State. sunithaever@yahoo.co.in
Second Author – A.Madhav, M.D.(Gen.Med), SRRIT&CD/ Govt. Fever Hospital, Osmania Medical College, Hyderabad, Telangana State. madhav1371@yahoo.com

Third Author – Meera M, M.D, SRRIT&CD/Govt. Fever Hospital, Osmania Medical College, Hyderabad, Telangana State. dr.meera.s@gmail.com

Correspondence Author – Sunitha B, sunithaever@yahoo.co.in
Contact number: +91 9010133116

Securing NFC application data with combination of CLOUD (as SaaS Service) and secure element

Sarabjeet Singh*

*Research and Development, Syscom Corporation Limited

Abstract- Near field Communication (NFC) technology provides many possibilities in consumer application domain other than just payment applications as it provides characteristics such as contactless communication and exchange of information between devices. But it has some limitations and restriction on data storage and security. To overcome these limitations a combination of CLOUD as SaaS services and secure element can be used. This paper describes how the combination of ‘Software as a Service’ feature of Cloud technology and Secure Elements (SIM cards) can be used to overcome these limitations. This paper does not goes into implementation details on coding side but provides a basic flow of solution implementation.

Index Terms- NFC, Secure Element, Cloud, SPI, SaaS, ACE

I. INTRODUCTION

Near Field Communication technology is in the market since a while now. NFC application allows communication with many applications and devices therefore this application requires security measures to control access to the available data on the devices and also requires the security of data on the device itself. While not all NFC applications require security, but those who allows/supports financial transactions certainly do require some security measures. One of the security measures is use of “secure element”. Secure element can exist within the phone itself or within a smart chip essentially a NFC chip. This secure element is used to securely store applications and/or credentials and provide for secure execution of applications. Here the secure element is a secure area of environment on which NFC application code and its related data is processed, stored and administered.

For NFC applications, data can also be stored on either a secure element or on the Mobile equipment NFC enables Card. Table1 lists some of the available NFC chips with their memory information. NFC chips can have different sizes of memory and similarly can have different memory configurations. This affects the amount of information that can be stored on certain chips but it also affects how the chip can be locked and other very important factors. The table contains two memory listings:

Memory Size: It is the total amount of memory within the chip. Some of this are one time programmable (OTP), some will be for locking features and so on. Most will be for user read/write functions.

User Memory: This is the memory that is important to a user because this is the available memory that a user can use to store the data.

Table 1 : NFC chips availed in Market

NFC Chip	Memory Size (bytes)	User Memory(bytes)
Ultralight	64	48
NTAG203	168	144
NTAG210	80	48
NTAG213	180	144
NTAG215	540	504
NTAG216	924	888
Ultralight C	192	148
Mifare 1k	1024	716
Desfire 4k	4k	4094
Topaz 512	512	454

There are three problems with these secure elements:

First with secure element used on the device itself has a risk of data loss with loss of device and issue of data compromise as some other application can access the data stored by the NFC application without the knowledge of the user.

Second problem is with the used NFC chips. Firstly, not all chips or smart cards are NFC enabled secondly as shown in Table 1; the user memory space is limited so it has limitation on how much data can be stored on the card.

Third problem is the access to the NFC enabled smart cards. As there are many methods and APIs such as OpenMobile API available that can be used in development of NFC applications, these applications can access Smart card and the applications on it easily. If not controlled, these applications can also store and access data that they should not store/access.

Research Elaboration for proposed solution- Basic thought behind this paper is to provide an approach and solution to secure the NFC application data and provide measure to access the data in a secure and controlled way.

For this purpose, a combination of CLOUD computing services and secure element can be used. Here we are taking secure element to be the smart card used for NFC transactions. Global platform has provided specification for secure elements access based upon which restrictions can be applied on android applications on how they should access secure elements. These restrictions can be used to store data processed by NFC applications so that they do not need to rely on any other security application of securing the data. For this we will use both secure element and Software as Service characteristics of Cloud Services.

II. PROPOSED IMPLEMENTATION

Following tasks are required to implement the proposed solution for securing the NFC application data:

1. Move the Mobile backend and storage of data to Cloud Storage instead of using local storage on device.
2. Implement a Security Middleware to control and authentication access to Cloud from the application
3. Access the smart card in controlled and secure manner to store sensitive information.

A. Moving Mobile backend and storage to Cloud

We all know that Android Applications are capable using cloud storage. Cloud provides three types of services, namely: Software as a Service, Platform as a Service and Infrastructure as a Service. These three services constitute the SPI model of cloud. For this solution, Software as a Service will be used. In this, access to cloud applications is provided over internet and services can be accessed by any device capable of connecting to internet and have a user interface. Following figure depicts an access model from android to Cloud as SaaS service:

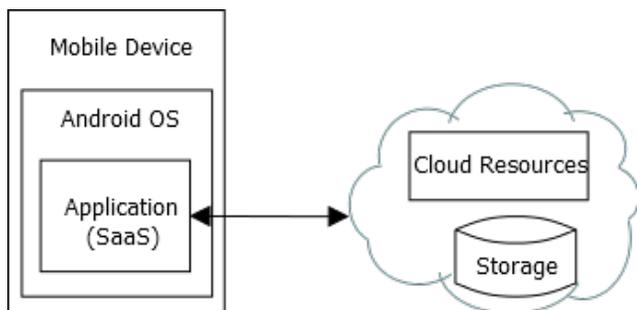


Figure 1: Cloud Access (SaaS)

Whenever an NFC application need to store data it should access cloud storage and store the data on it this proposal assumes cloud implementation on Google Cloud Platform. Google Cloud Platform provide Google App Engine on which mobile backend can be developed and custom code can be run and can be accessed by the client Applications running on mobile devices using Google Cloud Endpoints. Endpoints provide methods to use REST API from communication and consuming REST APIs from Android.



Figure 2: Google cloud access by Cloud Endpoints

It also provides OAuth2-based authentication, so that the mobile backend code can know the identity of the caller service.

B. Security Middleware

Now that most part of the application is on cloud, access to the cloud service needs to be secured from cloud end. For this a seed based key will be used for user authentication to cloud service. This key will act similar to as a password but will be generated at both the cloud end and at the client end. A Seed key of 1 KB will

be provided to user. This will be stored on the SIM card or secure element itself. A permanent user ID will be provided to each user. With the combination of the Seed and ID a key will be generated that will be used for authenticating the session.

After generation of the secret key, it is required to secure the key also so that spoofing attacks can be avoided. For this 3DES encryption will be used to encrypt the key. This encrypted key will be used by the application along with other information for authentication. The transfer will occur in JSON format. The transfer mechanism can be written in any format for example as a REST service. Following will be the format of the JSON. This format is not mandatory and can be modified according to requirement. It is indication of what can be sent in string and how can be sent:

```
[
  {
    "userId" : "userId"
    "appId" : "Application ID trying to authenticate with Cloud"
    "service" : "Required Service "
    "_id": "XXXXXXXXXXXXXXXX",
    "_ids": "553c73fa5e3d8b91473529b2",
  }
]
```

Following figure shows key generation encryption and authentication process:

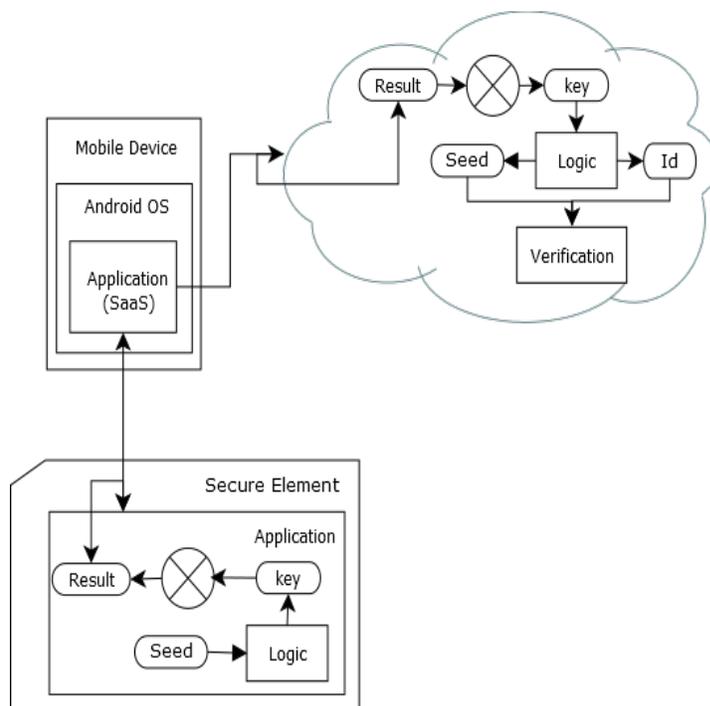


Figure 3: Authentication and Key Generation

C. Controlled Access to Secure Element by Android Application

Third part is to control access of the android application. Since new business opportunities allows the application developers to take advantage of android-secure element interactions. GlobalPlatform has defined a standard that enables several

application development companies to manage their stakes in a single Secure Element. APIs such as OpenMobile API has allowed the applications to exchange data with the applications running on secure element as in our case the key generation application runs on secure element. Now other than this applications, there are other applications that uses such APIs also and since do not provide an efficient mechanism to prevent unauthorized parties from abusing the API and potentially causing damage to the Secure Element itself, therefore we need to control this access. Global Platform "Secure Element Access Control" specification has provided generic mechanism for access control that is applicable for any kind of secure element: embedded SE, micro SD or NFC chip. There are two main parts of this secure access architecture: Access Rule Enforcer is the Device Itself and the Access Rule Application that should be used to access the application on the secure element. Simply stating following process happens in this access control:

1. Card issuer defines rules for controlling the access for secure element applications.
2. There is an access control master application which is supplied those rules.
3. When a device application has to access the SE application, the access control enforcer on the device should use the interface provided by the access control application to get the access rules from secure element.
4. Access is only permitted if the rules specify that access is possible to the application.

The access rule application is any SE application which can be selected by a GlobalPlatform-defined AID. GlobalPlatform Device Technology Secure Element Access Control (Version 0.10.0) provides complete description of how the access rules are to be implemented in the SE application and what is to be done with combination of the rules. Following depicts a particular access scenario:

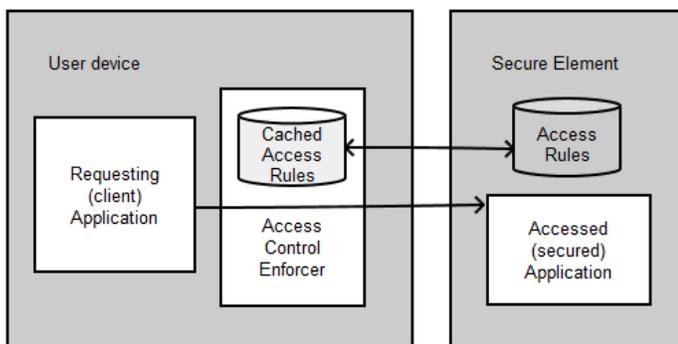


Figure 4: Enforcing access control

1. A client application signed with a unique key tries to access a specific application through its AID on a Secure Element.
2. ACE reads the AR for the specific AID and the applications certificate hash.
3. Grant access to the client application according to the access rule or deny access if no rule is found.
4. Client application can communicate with the SE applet if the command APDUs match the filter list (if given) checked by the ACE.

After complete implementation following will be the assumed complete application schema:

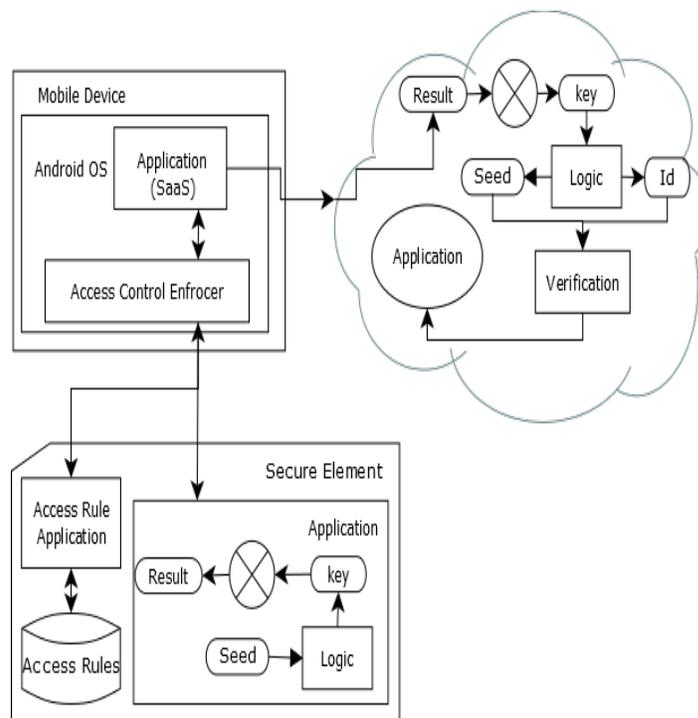


Figure 5: Complete Schema for implementation

III. CONCLUSION

NFC applications are full of potentials but constraints such as storage space and security issues are not allowing this technology to be used to its full extent to created enriched user experience applications. Cloud computing technology provides us many benefits such as centralized storage space, scalability and manageability, but most of all it provides device independence. With the help of cloud computing, device interface and back-end can be separated for added security. If Cloud is used with NFC, then potential of NFC application increases exponentially. Plus secure elements provide security at the client side for important information such as user credentials. Using Global Platform Access Control mechanism, secure access to NFC applications can be allowed to secure elements. Added benefit, the secure element in such implementation need not to be an NFC chip for such operations.

REFERENCES

- [1] GlobalPlatform System Messaging Specification for Management of Mobile-NFC Services Version 1.1.2
- [2] GlobalPlatform Card Specification v 2.2.1, January 2011.
- [3] GlobalPlatform Card, Confidential Card Content Management, Card Specification v2.2 – Amendment A, v1.0.1, January 2011.
- [4] Global Platform Secure Element Access Control v0.10.

AUTHORS

First Author – Sarabjeet Singh, Masters of Computer Applications, sarabjeet.singh2610@gmail.com.

The knowledge management strategies used as a tool within and through strategic consulting firms to increase the organisational performance

Fatimetou Zahra Mohamed Mahmoud, Ahmed Mohamed Mahmoud, Jamaludin Ibrahim

Faculty of Information and Communication Technology, IIUM, Kuala Lumpur, Malaysia

Abstract- As a matter of fact, the rising awareness in organisations to not focus only in the physical assets in the organisation but also in other paramount assets such as knowledge was the launching point for organisations to go to the implementation of knowledge management and creating knowledge management strategies codified or personalized in order to overcome issues and plan for its future sustainability and development. Actually, the implementation of knowledge management strategy is the strategic consulting company internal asset and external mean to get value. Although, after the implementation of knowledge management strategy in some companies they face the problem of the low revenue and efficiency of the strategy implemented. That's why the combination of the codification and personalization make the organisation able to create, share, save and re-use knowledge and exchange it in the organisation using technology or informal communication networks in order to raise the innovation in the work environment and the creation of new ideas and services. Also, this knowledge stored and codified especially about the organization customers can be considered as the basic knowledge to take the strategic decisions and by KM the organisation will be able to extract, understand and well use this knowledge in order to strengthen the relation with its customers and allow them to become the organisation's partners and advisors. Indeed, that's mean that the organisation strategy must be renewable and in corporation with the overall business model and focus on the core competence in the organisation and the management of the customer knowledge and interactions, this will influence positively and upgrade the organisational performance in any organisation.

Index Terms- Knowledge management, Strategy, Consulting firms, organisational performance

I. INTRODUCTION

Nowadays, there is a significant awareness in all the modern organisations and it start to recognise and know the importance of considering the knowledge as a valuable asset in the organisation that can be managed.^{[1][2]} Actually, knowledge can be divided into two types the explicit knowledge which is the documented and codified knowledge and in this kind of knowledge information technology play an important role to share and save this knowledge by the use of systems and the latest technology in the organisation. Furthermore, the second type is the tacit knowledge which is the knowledge that comes by

experience in work, intuition and maybe we do not know that we have it or how to explain it, this kind of knowledge can be shared by the interaction and the well communication environment between workers in the organisation.^{[3][4]} From this understanding of knowledge we can say that in a learner and smart organisation, knowledge management is considered as the combination of people, processes, tools and technology to acquire, learn, create, renovate and share knowledge in order to optimise the employment and the well use of this knowledge in the organisation in order to increase the organisational performance and ensuring it's sustainability.^{[1][5][6][7][8]}

In fact, the consulting firms had the precedence to invest in knowledge management. Furthermore, there are different strategies to involve the knowledge management within the consulting companies or any other organisation. The strategies are the codification strategy based on computers and databases to save the knowledge and second strategy is the personalization strategy based on communication among people in work.^{[9][10]} Indeed, any organisation must know and have a clear vision why it need to develop a knowledge management strategy what is the goal of this implementation, in what it can help the organisation to be developed and it should be aligned with the organisation overall strategy. In this situation the consulting firms play an important role to help the organisation to identify clearly what are the weaknesses, the issues in the organisation that need to be resolved and to focus on helping the organisation to keep and attract customers by implementing a knowledge management strategy which will be related to the global long-term vision of the organisation and supply a framework that will help the organisation to resolve and overcome those issues and increasing the business and organisational performance.^{[2][9][11]}

II. LITERATURE REVIEW

In fact, consulting firms are the more concerned by knowledge because it represent an asset, resource, product or even a service which help the consulting firm to create value and benefit, that's why they need a strategy to manage this knowledge and be able to sale it as their business. The authors Sven, Dirk, Dietrich and Chiara did an analysis on the correlation between the knowledge management strategy and the business model of the organisation. Actually, the management consulting firms provide advice to the organisations relating to the strategy, operations or information technology based on knowledge to add value to the organisation and to improve their performance. Commonly the consulting firms forward one of two business

models, the first one is the creation of high customised solutions by the firm for a significant and unique issues by providing original and analytical advices based on experience and tacit knowledge ,this kind of strategic consulting firms business model focus will be to preserve a high profit for the organisation, whilst the second business model followed by the consulting firms is the providing of a high standardised products and services due to their dealing with the same issues thus they reuse their existing modules and they continue to create new modules and pieces in order to generate great revenues.^[12]

In the other hand in consulting firms the knowledge management strategy follow specific goals, techniques and technology and the generation, distribution, maintenance of knowledge in each process is controlled centrally which mean the knowledge will be codified, stored in data bases and documented or de- centrally which mean a personalized knowledge attached to the person who acquire it. Then the authors consider that the firms which has a standardized business model should focus on the central knowledge management strategy, whereas the consulting firms that provide the customised solutions should focus on the de-central knowledge management strategy because in this case the codified knowledge will have a limited value for the organisation and they need to utilize the tacit knowledge and experience to innovate solutions. Furthermore, this analysis was proved after studying the business model and knowledge management strategy in the case of leading companies each one in a specific sector such as Mckinsey, Accenture, Price water house Coopers, and prognos AG.^[12]

Another study analyse the two types of strategies the codification and personalization from a marketing perspective to optimize the efficiency of knowledge reuse. Actually, one of the issues is that many organisations suffer due to the depressed returns from the investment in knowledge management. Thus, to significantly increase the efficiency of transferring knowledge among consumers and producers, we should first know that the inefficiency of knowledge transfer is due to the diverse priorities and agendas of the producers and consumers pending the knowledge exchange and share. Indeed, the authors after developing a model to help in maximizing the efficiency of knowledge reuse and transfer they found that the two strategies codification and personalization should be combined together to enhance the efficiency of knowledge reuse.^[13]

From another point of view, a study and research was done by Zhu Yu, Wang Yan-fei and Lan Hai-lin with the participation of 223 enterprises in China to recognize the relation between the knowledge management strategy, the core competences and the organizational performance.^[14]

Actually the study found that, firstly for an organisational future development there should be coordination between the knowledge management strategy and the core competence in the organisation. It's because the core competence represent the intermediate to create an impact and effect of the knowledge management strategy on the organizational performance and the organisation should pay more attention and focus in the developing of their core competences as well as their strategy to ensure a long- term development and sustainability. Secondly, the researches demonstrate that the greatest impact on human resource competence and efficiency is from the knowledge

management strategy and the core competence in the organisation. In addition, the knowledge sharing culture has to be developed in any organisation. Actually, by the implementation of a codified knowledge management strategy the organisation will build a sharing mechanism by the capture, save and reuse of knowledge and it start by the spread, educate and aware employees to better understand what is the sharing culture and how it represent a benefit for the employees and for the organisation.^[14]

To resume the study found that the two knowledge management strategies have different impact and influence in the organisation, actually the personalization strategy has a positive impact on the core competence while the codification knowledge management strategy has a positive impact in both the core competence and the organizational performance.^[14]

Actually we cannot forget the significance of technology in the improvement and development of any organisation, from this standpoint Barney, Shan and Ray had did an analysis study on a successful case in Singapore to see how in specification the web technologies can improve the organisational performance in dependence with the global organisational environment. In fact, the authors found that the web technologies can play an important role to assist the organisation business strategy and optimizing its performance. Furthermore, to have an effective influence of web technologies in the organisation the organisation should not depend on the technical concession but in the complicated fit among the strategy, the technology and the external environment. Indeed, the equilibrium in the organisation environment help the web technology to improve the organizational performance by simplifying the realization of competitive features using three different mechanisms "*the logics of positioning, leverage, and opportunity*", reciprocally in the revolution state of the organisation environment "*Web technologies can give rise to performance gains by supporting the attainment of legitimacy through two distinct mechanisms: the logics of optimality and social congruence*".^[15]

In the same context, another research has shown how the combination between the technology and the knowledge management can be a tool to increase the performance and the profit of the organisation which is the use of customer relationship management (CRM) in integration with knowledge management. Actually CRM as an approach based on strategies and technology help the organisation to ameliorate its business relationship with customers by collecting information about their customers through various points of contact among the organisation and its customers such as the social media, organisation's website, email, call centre and different marketing tools. Thus to achieve this the organisations use different software's to store all the customer information into a single database to record the customer interactions and the automation of workflow processes. But, this information stored in big database cannot be significant and play a role to maintain permanent customers and increase the production and long-term profit in the organisation if this information is not well managed, organized, connected and distributed and here the knowledge management can play a role to extract the meaningful knowledge from those information to transform it into valuable information that can be analysed to attract customer and improving the business performance in the organisation. Indeed, the

combination of KM and CRM can help to use the knowledge for, from and about customers by the experts in the organisation in order to attain the organization goals and optimizing its business and organizational performance.^{[16][17]}

One of the successful organisations IBM traditionally was known as a company that have a profound experience in information technology and in their old business model the company was depending on the sale of hardware to get revenues. However, IBM has recognised that the organisations start to give more attention to the strategic value in information technology tools and re-engineering projects and those projects should be linked with the overall business strategy of the organisation. For this, in order to keep up and react with the business environment IBM has created the IBM global services business unit, then the largest acquisition on the IBM history was done by acquiring the Price Waterhouse Coopers (PwC) which is a consulting firm that provide information technology services and IT management consulting. Furthermore, IBM had create a new unit which is IBM business consulting services to combine the global services business unit and the PwC consulting.^[18]

Actually, with a very large number of consultants in different countries IBM has become one of the largest consulting services organisations. In the other hand, IBM consulting has involve the intellectual capital management (ICM) in order to formalize the knowledge management over the IBM services and industries and give more attention to the acquire, creation, sharing, using and transferring knowledge in order to ensure the development of the organisation.^[18]

In fact, the knowledge management strategy of IBM included the linking between the strategy and the intellectual capital of the company, the creation of a culture based on knowledge, creating processes and infrastructure that help to crate and share knowledge, using technology for sharing knowledge, and the measurement of the intellectual asset sharing effectiveness. Also, one of the IBM priority was to raise the capability of the consultants group to share their knowledge and be able to merge it rapidly in response to the client need by the creation of informal networks as a way to maximize the internal team work liberty to act and share knowledge. Thus, the knowledge management in IBM was based on the society network and what differentiates the process of knowledge management in IBM is the use of the SNA (social network analysis) as a tool to analyse and check the knowledge network characteristics and as a change management initiative.^[18]

Furthermore, IBM had realize that the real value come from crating and sharing knowledge, and actually the valuable knowledge of the company come from the heads of the talented employees. Indeed, IBM in order to ensure its sustainability an maintain a reputable brand in consulting need to merge the two knowledge management strategies the top down centralized and the bottom-up decentralized approaches in order to build trust in the work environment, exchanging talents internally as the case of Mckinsey consulting firm where the consultants nominate themselves for a specific project and then they make the manager bid for them, actually this exchange mechanism help the best employees to distinguish their experience and knowledge.^[18]

As a matter of fact, IBM is known as an ongoing strategic renewal company as mentioned by the authors Edna and Tuvya.

The success of IBM all over the years was based on a strategic conjunction of innovation in business management and technology. Actually, in the level of technological innovation IBM is known as one of the company that have the largest research and development set and the success of this set is due to the management of employees and their knowledge. Furthermore, due to the research and development set, IBM invented as a business model the employment of personal computers, then the mobile computing and the think Pad, after this IBM has made a great transformation by focusing on providing consulting to clients. Thus, IBM was a company that make many transformations according to the market changing and needs.^[19]

In the level of business management innovation, IBM had a long term vision that was the cause of its success today as a company that supply services and solutions, hardware, software with a very profound knowledge in the different fields to which the company supply its services. Also, IBM initializes the internal innovation in the company by focusing and giving importance to processes such as the global brainstorming. Actually, innovation is one of the important sources which is extracted from the internal communication network in the organisation that regroup a very large number of customers , employees and business partners in order to share the new services, ides, conducting debates and much more.^[19]

III. LITERATURE FINDINGS

The general awareness in organisations from different fields and sectors on the importance to consider knowledge as a valuable asset, give raise to the important role of strategic consulting firms which are themselves need the knowledge internally as an asset and resource, to create product or a service in order to get value and benefit, or externally to sale it as their business by implementing strategies to manage knowledge in other organisation from different fields.

Actually, there is two types of knowledge management strategies used within and through the consulting companies which are the codification and personalization strategies. Indeed the implementation and the success of the knowledge management is by the combination of this two strategies which mean that the knowledge should be saved and codified to simplify its reuse and in the same time it should be exchanged through the personalized strategy. In addition, this combination of two strategies should be related to other components of the organisation such as the technology role, the business model role, and the importance of core competences and the creation of a sharing culture, the importance of the intellectual capital and its assessment and the rapid adaption to the market change.

As a result, the combination and the alignment of the components mentioned before with the knowledge management strategies can play an important role to increase the organizational and business performance significantly and ensure the development and the sustainability and help it to keep a high level of their customer satisfaction of the organisation such as the successful case of IBM Company.

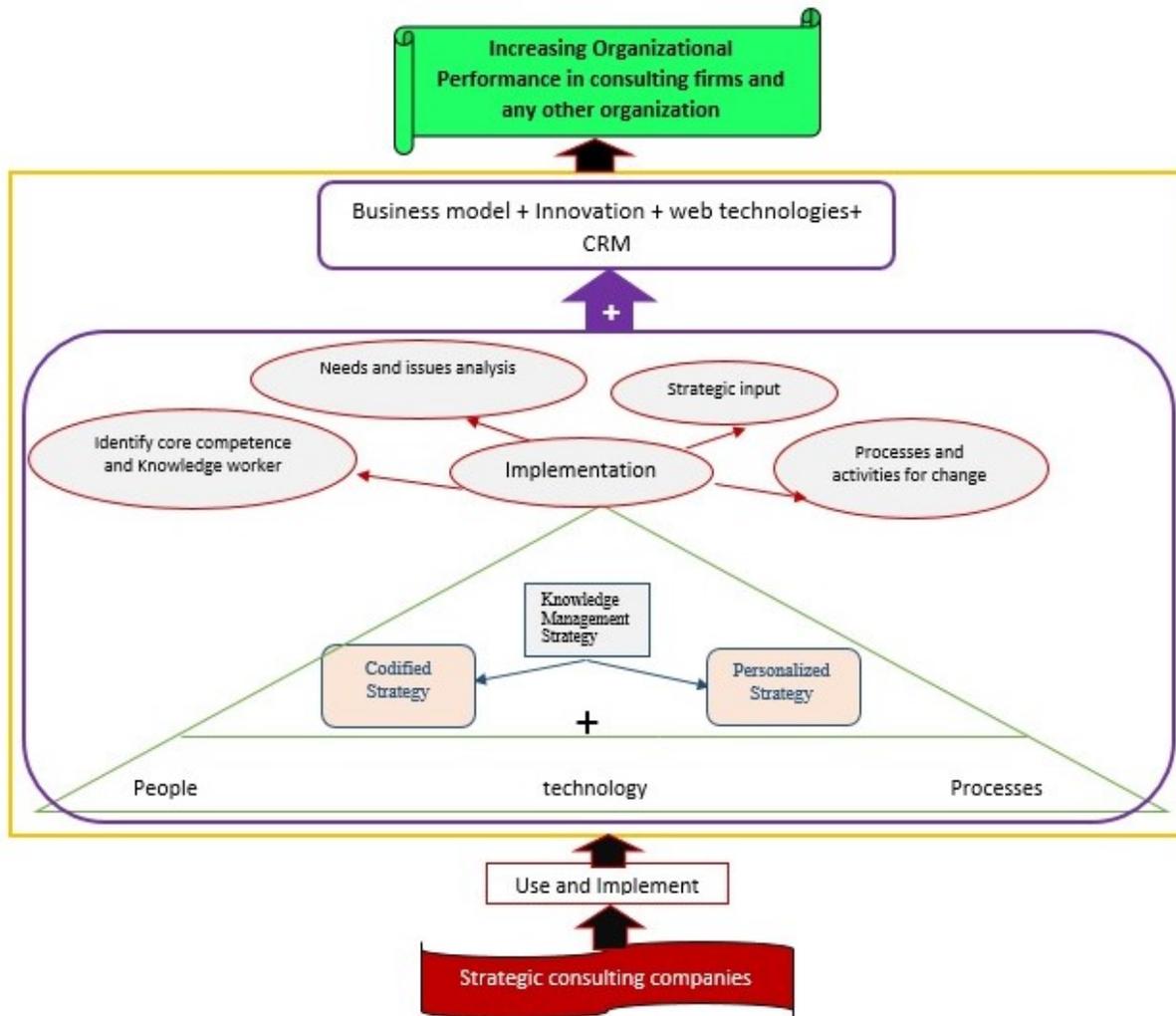


Figure 1

In the figure above we see how the strategic consulting firms use and implement the knowledge management strategies in addition and alignment with the business model, by focusing in the innovation in the organisation and the use of technologies such as the web technology and the customer relationship management systems. All of these components together lead to the increase in organisational performance in the consulting firm itself and in the other organisations that the consulting firms help to improve their situation and resolve their issues.

IV. CONCLUSION

In short, the knowledge management strategy help the organisation to analyse its need, issues, and innovate solutions and plans for the development of the company and its sustainability by reaching a high level of satisfaction from its customers and increasing the interactions with them by using technology and systems or by the direct communications and interviews which make the customers partners in defining the organisation future, and this is the goal of consulting firms in the implementation of a knowledge management strategy in an organisation. Actually, the successful implementation of knowledge management strategy in consulting firms or by

consulting firm to another company play a major role in contribution with other components such as the business model to have a significant potential increase of the organisational performance in the organisation.

REFERENCES

- [1] Edna Pasher, TuvyaRonen."The complete guide to knowledge management".Wiley. February 8, 2011
- [2] Paul S. Chinowsky, School of Civil and Environmental Engineering Paul S Chinowsky, Anthony D. Songer."Organization Management in Construction". First edition. Jan 12, 2011. 216 pages.
- [3] Alaaeddin M. Abed, Md. Mahfuzul Islam, Khalid Helal, Mohamed Abdirahman, Abdirizak Mohamed, Dr.Jamaludin Ibrahim." The Manager and User's Role in IT Use as a KM Tool". International Journal of Scientific and Research Publications, Volume 4, Issue 12, December 2014
- [4] KimizDalkir, McGill University. "Knowledge management in theory and practice". Elsevier Butterworth-Heinemann.
- [5] Gul Muhammad, Jamaludin Ibrahim, Zeeshan Bhatti*, Ahmad Waqas." Business Intelligence as a Knowledge Management Tool in Providing Financial Consultancy Services". American Journal of Information Systems, 2014, Vol. 2, No. 2, 26-32
- [6] DanijelaJelenic. Faculty of Economics, university of Nis, republic of Serbia." The importance of knowledge management in organizations – with emphasis on the balanced

- Scorecard learning and growth perspective". Management knowledge and learning. International conference 2011.
- [7] Kamran Nazari, Department of Business Management, Payam Noor University, Kermanshah, Iran. Mostafa Emami, Young Researchers Club, Kermanshah Branch, Islamic Azad University, Kermanshah, Iran." Knowledge Management: FROM THEORY TO PRACTICE". Australian Journal of Business and Management Research. Vol.1 No.11 [22-30] | February-2012
- [8] Gillingham, Helen, and Bob Roberts. "Implementing knowledge management: a practical approach." Journal of Knowledge Management Practice 7.1 (2006).
- [9] Morten T. Hansen, Nitin Nohria, Thomas J. Tierney. "What's your strategy for managing knowledge?". Harvard Business review. March-April 1999
- [10] Karsten Jahn. "Knowledge management strategies". January 12, 2013. Retrieved from: <http://studies.k-jahn.de/2013/01/12/knowledge-management-strategies/>
- [11] Manjeet Sharma. "Knowledge management: principle and strategy". Published by: Sai Om Journal of Commerce & Management. Volume 1, Issue 10 (October, 2014)
- [12] Sven Grolik, Dirk Kalmring, Dietrich Lehner, Chiara Frigerio." Analysis of Interrelations between Business Models and Knowledge Management Strategies in Consulting Firms". KM Strategies in Consulting Firms
- [13] Kah-Hin Chai, James Nebus." Personalization or Codification? A Marketing Perspective to Optimize Knowledge Reuse Efficiency". IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT, VOL. 59, NO. 1, FEBRUARY 2012
- [14] ZHU Yu, WANG Yan-fei, LAN Hai-lin." Empirical Study on Interaction among Knowledge Management Strategy, Core Competence and Organizational Performance". Collage of Business Administration, South China University of Technology, P.R.China, 150001
- [15] Barney C. C. Tan, Shan L. Pan, Ray Hackney." The Strategic Implications of Web Technologies: A Process Model of How Web Technologies Enhance Organizational Performance". IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT, VOL. 57, NO. 2, MAY 2010
- [16] Ali Attafar, Majid Sadidi, Hamideh, Attafar, Arash Shahin. "The Role of Customer Knowledge Management (CKM) in Improving Organization-Customer Relationship". Middle-East Journal of Scientific Research 13 (6): 829-835, 2013
- [17] Nour Mohamed Yaghoubi, Seyed Mohamed sadeq, Seyyed Ali, Asghar Afshar Jahanshahi, Khaled Nawaser. "The role of knowledge management on customer relationship management". European Journal of Economics, Finance and administrative sciences, Issue 34(2011)
- [18] Kylie Summerhayes, Steven Luo." Managing Knowledge in Professional Consultancy". Monash Business Review Volume 2 Issue 3-November, 2006
- [19] Edna Pasher, Tuvya Ronen. "The complete guide to knowledge management". Wiley. February 8, 2011. (Pages: 42, 43, 44)

AUTHORS

First Author – Fatimetou Zahra Mohamed Mahmoud, Faculty of Information and Communication Technology, IIUM, Kuala Lumpur, Malaysia

Second Author – Ahmed Mohamed Mahmoud, Faculty of Information and Communication Technology, IIUM, Kuala Lumpur, Malaysia, Email: Kdm.et2001@gmail.com

Third Author – Jamaludin Ibrahim, Faculty of Information and Communication Technology, IIUM, Kuala Lumpur, Malaysia

Hemiogenesis of Thyroid Gland: A Case Report

Dr. Swapna A. Ambekar*, Dr. Priya P. Wattamwar**, Dr. Azhar A. Siddiqui*** & Dr. Hussain R. Zuberi**

* Associate professor, JIU'S IIMSR, Warudi

** Assistant professor, JIU'S IIMSR, Warudi

*** Professor and Head JIU'S IIMSR, Warudi

Abstract- Thyroid is a highly vascular endocrine gland which is placed anteriorly in the neck. Thyroid hemiogenesis is a rare congenital anomaly in which one thyroid lobe with or without an isthmus fails to develop. We are presenting such a case detected accidentally during routine cadaveric dissection. This condition usually is undiagnosed as it leads to symptoms only when it is associated with other conditions. It is one of the contributing factors for hypothyroidism. It may develop as a sporadic case or familial or due to some genetic abnormalities. Four different genes were identified for development of thyroid but every case of hemiogenesis was not associated with mutations of these genes. Molecular mechanism of development of hemiogenesis needs to be explored.

Index Terms- Thyroid gland, Hemiogenesis, Hypothyroidism, Thyroid anlage, Transcription factors

I. INTRODUCTION

Thyroid is a highly vascular endocrine gland which is placed anteriorly in the neck. It extends from the C₅ to T₁ vertebrae. The gland is composed of two lateral lobes which are connected by a narrow median isthmus measuring 1.25 cm transversely and vertically. It corresponds to the second and the third tracheal rings.

Thyroid hemiogenesis (THG) is a rare congenital abnormality in which one thyroid lobe with or without an isthmus fails to develop^[1]. The first case of thyroidal hemiogenesis was described in 1866 by Hansfield Jones^[2], since then approximately 285 cases have been reported in the literature till 2005 and so it is labeled as a rare condition^[3].

Hemiogenesis as such is seldom responsible for the clinical presentation but it is usually associated with other conditions leading to symptoms; such as Hashimoto's thyroiditis, multinodular goiter, hyperthyroidism, Grave's Disease, hypothyroidism, adenoma, adenocarcinoma, chronic thyroiditis or subacute thyroiditis^[1,3,4,5]. It is detected either accidentally during dissection or while investigating for any other associated pathological condition or during routine screening ultrasound of neck in school children^[3].

II. AIM OF THE STUDY

Objective of the study is to discuss hemiogenesis of thyroid with

- its incidence,
- to focus on genetic and embryological aspect of development of such a variant and

- to add a rare case to the literature

III. CASE REPORT

During routine cadaveric dissection in Department of Anatomy at JIU's IIMSR, Warudi, agenesis of left lobe of thyroid gland was noted in an old male cadaver. Right sided blood vessels were the sole supply of right lobe. The specimen was carefully dissected and photographed.

Further details about thyroid disease or medication were not available but histological study of right lobe revealed normal thyroid anatomy. There were no signs of any operation around neck.

IV. DISCUSSION

Hemi is a Greek word meaning half and agenesis is a Latin word meaning absence or lack or failure of development. We use hemiogenesis synonymously for the partially developed thyroid. It may be failure of right or left lobes with or without isthmus. The anomalies of the development of thyroid gland distort the morphology of the gland and may cause clinical functional disorders and various thyroid illnesses. About 5% of the world population is affected from various thyroid diseases^[6].

Persistence of pyramidal lobe, thyroglossal cysts, agenesis of the thyroid gland and aberrant thyroid are the major developmental anomalies observed in the thyroid gland^[7]. Though THG is rare, the exact prevalence cannot be postulated as the condition is usually accidentally detected either during dissection or because of the clinical symptoms associated with such a variant. The prevalence was estimated between 1:1900 to 1:2675 (Shabana et al)^[3]. It varies between 0.02 – 0.05 % as studied by various researchers. Interestingly, THG is more observed in girls than boys. The incidence of left to right is 4:1^[7, 8, 9, 10, and 11]. Absence of the left lobe occurs in 80% of THG and agenesis of the isthmus occurs in 50% of cases^[7].

Morphogenesis of thyroid follicular cells is often disturbed in newborns, resulting in a set of conditions collectively known as thyroid dysgenesis (TD). TD is present in 85% of congenital hypothyroidism (CH), a condition that affects 1 of 3500 newborns worldwide^[12]. Castanet et al^[9] (2005) studied 22 patients with THG retrospectively. He noted normal hormonal levels in the majority of THG patients (59%), which could suggest that a single thyroid lobe was capable of covering hormone requirements. The probable explanation for left sided incidence is agenesis of paired organs is also more likely to occur on the left side.

Thyroid has an asymmetric shape, the right lobe being larger than the left, also the lobe size is reversed in patients with dextrocardia^[12]. Thyroid hemiagenesis, could, therefore be considered an exaggeration of this difference, producing an extreme asymmetry of the thyroid gland. THG is more frequent in the female sex, because of a selection bias due to the fact that thyroid diseases are more frequent in women^[8].

Most of reported cases of THG were sporadic; a few were familial with genetic predisposition to hemiagenesis. Enzyme deficiencies associated with hemiagenesis were common causes of hypothyroidism^[1].

A hypothesis put forward in 1949 incriminated congenital unilateral absence of the thyroid vasculature, but some patients with THG have been reported with normal vasculature. In contrast, vascular anomalies of the thyroid are reported in patients with normal bilobed gland^[9]. In our case, left sided superior and inferior thyroid arteries were absent.

Humoral or environmental factors controlling the descent and development of the thyroid gland may influence hemiagenesis; but there has to be genetically determined mechanisms^[9].

Embryologically, thyroid is first endocrine gland to start developing in embryo^[13]. It begins to form about 24 days after fertilization, from a median endodermal thickening situated in the floor of the primitive pharynx near junction of first & second pharyngeal arches. Thickening lies between tuberculum impar and copula respectively. This thickening soon forms a small outpouching called thyroid primordium. As the tongue grows, the developing thyroid gland descends through the neck, passing ventral to the developing hyoid bone and laryngeal cartilages. At first the thyroid primordium is hollow but it soon becomes solid & divides into right and left lobes connected by the isthmus. Initially thyroid gland is connected to the tongue by a narrow tube (thyroglossal duct). With further development, this tube disappears by the end of 5th week and the isolated thyroid gland now consisting of lateral lobes connected by a well defined isthmus continues to descend. By 7th week, the gland reaches its destination and also assumes its definitive shape. Proximal opening of the thyroglossal duct persists as a small pit in midline of the tongue – the foramen caecum, near the junction of anterior 2/3 and posterior 1/3 of tongue^[1]. Molecular mechanisms involved in the translocation of the thyroid primordium have not been completely elucidated^[12]. Aberration in development can lead to various anomalies like persistence of thyroglossal duct, thyroglossal cysts, fistula, sinuses, ectopic thyroid tissue, and absence of a part or whole of the gland. These anomalies may be asymptomatic or may cause functional disorders and may be cause of surgical failures and complications^[9].

Various theories have been proposed on the thyroid organogenesis. It has also been proposed that the lateral thyroid lobes derive contributions from caudal pharyngeal endoderm (4th and 5th branchial pouches). They arise later in the development than median component. The median and lateral thyroid components unite by complicated mechanisms. Conversely, recent literature states that thyroid rudiment is derived solely from the median thyroid anlage as mentioned above^[14].

Congenital thyroid gland anomalies occur either as a result of failure of differentiation of the embryonic fields within normally located thyroid tissue or as a result of abnormal

location of the thyroid gland in the midline of the neck along the thyroglossal tract (ectopic). The cause of unilateral agenesis of the thyroid gland is unknown but it may arise from the failure of the original analogue to become bilobed and spread out laterally to both sides. Congenital thyroid anomalies are associated more with hypofunction than with hyperfunction^[2]. Persistence of thyroglossal duct leads to formation of pyramidal lobe or levator glandulae thyroideae. High division of thyroglossal duct results information of two independent thyroid lobes with no isthmus^[15].

Raffaella Maiorana^[8] noted that patients of TGH have a pituitary thyroid axis set at a different level leading to higher frequency of hypothyroidism or other thyroid. It produces subtle abnormalities of thyroid function which may or may not be clinically relevant but it maintain patient in a situation of thyroid tissue overstimulation. Such patients are at high risk for goiter and hypothyroidism.

The occurrence of thyroid hemiagenesis among monozygotic twins, among sisters, or together with other thyroid malformations within one family suggests genetic predisposition. Several genes such as thyroid-specific transcription factors TTF-1 or Nkx2.1, TTF-2 or FOXE1, and Pax8 have been found to control thyroid descent, development and morphogenesis^[3]. Castanet^[8] observed four genes in thyroid gland development; three encode thyroid enlisted above and one encodes the TSH receptor gene. Analysis of the candidate gene Pax8 in his cohort found no mutations, suggesting that Pax8 may not be a key genetic factor in this disorder and that other genes may be involved.

Gangbo et al^[16] observed agenesis of isthmus of thyroid in a case of trisomy 22 and hence suggested that chromosome 22 could play a role in the thyroid development.

According to Langman^[17], in the developing embryo, establishment of body axes, anteroposterior, dorsoventral and left right takes place before and during the period of gastrulation. The primitive streak is initiated and maintained by expression of Nodal, a member of TGF- β family. HNF-3 β maintains node and induces regional specificity. Left – right sidedness is orchestrated by cascade of genes. FGF8 secreted exclusively by the cells of left side of node and primitive streak. PITX2 is a homeobox containing transcription factors responsible for left sidedness. FGF8 and LEFTY-2 upregulates PITX2. So any defect in this gene cascade may be responsible for THG on left side.

Mario De Felice^[12] studied genetics and molecular mechanisms of developing thyroid in patients with dysgenesis. He stated cell interactions are required for normal organogenesis. He suggested influence of the developing heart on thyroid organogenesis as the cardiac malformations represent the most frequent birth defects associated with TD. He noted morphological and biochemical changes in thyroid cell specification, making them clearly distinct from their neighbors. Many disorders appeared to be derived from alterations of initial morphogenetic events. He found transcription factors Foxe1, Pax8, and Hhex to be expressed both in mature thyroid cells and in their precursors. When the thyroid diverticulum begins to migrate, the expression of these factors was restricted to the thyroid primordium as they were never expressed in the thyroglossal duct. In the primitive pharynx, Ttf1/Nkx2-1 was present exclusively in the thyroid anlage. Interestingly, he

identified *Titf1/Nkx2-1* mRNA in parafollicular C cells and in the epithelial cells of the ultimobranchial body which are neuro ectodermal in origin; end up in the thyroid gland in close proximity with the TFCs. He proved that *Titf1/Nkx2-1* is an essential requirement for the survival of thyroid cell precursors to prevent apoptosis. According to him, *Pax8* was not only required for the survival of the thyroid precursor cells but also holds a specific upper role in the genetic regulatory cascade, which controls thyroid development and functional differentiation. He revealed mutations in regulatory genes. Many cases of TD did not show mutations of *TITF1/ NKX2-1*, *FOXE1*, *PAX8*. So he expressed the possibility of mutations of other genes controlled by these transcription factors. So, ultimately, the exact molecular mechanism of development of THG was not given and it needs further research.

V. CONCLUSION

Thyroid Hemiagenesis can be associated with other types of dysorganogenesis or variations in the neurovascular relations. This knowledge should be borne in mind during operations around this region for safe surgery and better prognosis.

Though the genes responsible for development of thyroid are known, the exact gene for hemiagenesis still needs exploration.

REFERENCES

- [1] Prasad S. Singh R, kumar N etal Absence of Isthmus of Thyroid Gland - A Case Report IOSR-JDM. July 2014,13 (7), 32-34 www.iosrjournals.org
- [2] Zakir Ali, Kumaresan K. Thyroid Gland Hemiagenesis with Grave's Disease IJNM, 2005;20(2): 53-54
- [3] Buyukdereli G. Isa G, Mustafa K And Cem K Thyroid hemiagenesis: a report of three cases and review of the literature Annals of Nuclear Medicine 2005;19(2): 147-50
- [4] D. Nsame. A. Chadli, L. Hallab, S. El Aziz etal Thyroid Hemiagenesis Associated with Hashimoto's Thyroiditis Hindawi Publishing Corporation Case Reports in Endocrinology 2013, Article ID 414506, 3 pages <http://dx.doi.org/10.1155/2013/414506>
- [5] Prasad G Faiza S, Sharef M et al. Left thyroid hemiagenesis with multinodular goiter of the only remaining lobe Journal of Science2015, 5(5): 309-10

- [6] Dr. Hussein M. Anatomical Variations Of Thyroid Gland And Its Clinical Significance In North Indian Population G.J.B.A.H.S. 2013, 2 (2):12-16
- [7] Lokanadham S et al. Multiple Morphological Variations of Fetal Thyroid Glands in South Indian population JPBMS, 2012, 15 (11) pg 01-03
- [8] Raffaella Maiorana, Anna Carta, Giuseppina Floriddia, Daniela Leonardi, etal Thyroid Hemiagenesis: Prevalence in Normal Children and Effect on Thyroid Function J Clin Endocrinol Metab, April 2003, 88(4):1534-1536
- [9] Castanet M. Leenhardt L, Léger J,etal etal Thyroid Hemiagenesis Is a Rare Variant of Thyroid Dysgenesis with a Familial Component but without *Pax8* Mutations in a Cohort of 22 Cases Pediatric Research 2005, 57(6) : 908-913
- [10] Hamberger H, Hamberger SW. Thyroid hemiagenesis. Arch Surg 1970; 100: 319-20
- [11] Mikosch P etal Thyroid hemiagenesis in an endemic goiter area diagnosed by ultrasonography: Report of sixteen patients. Thyroid 1999; 9 (11): 1075-1084.
- [12] Mario De Felice And Roberto Di Lauro Thyroid Development and Thyroid Dysgenesis Endocrine Reviews, October 2004, 25(5):722-746
- [13] sankar D sankar D Sharmila P Susan etal Agenesis of isthmus of thyroid gland with bilateral levator glandulae thyroideae International Journal of Anatomical Variations (2009) 2: 29-30
- [14] Renu Kumar T. Pradeep PV., Ragavan M. Bilobar Thyroid Agenesis presenting with Adenomatous Isthmus and Hypothyroidism in a 13 year old girl: A Case report, Journal of Pediatric Sciences 2010;2(2):e21
- [15] Kulkarni V, Sreepadma S, Deshpande S ,Morphological Variations Of The Thyroid Gland Media Innovatica December 2012 volume 1 issue 2 pg 35 - 38
- [16] Gangbo E, Lacombe D, Alberti EM, et al. Trisomy 22 with thyroid isthmus agenesis and absent gall bladder. Genet Couns 2004; 15:311-5.
- [17] Langman's medical embryology Third week of development chapter 5, 11th Edition: Wolters Kluwer India; 2010 Pg 57-60

AUTHORS

First Author – Dr. Swapna A. Ambekar - MBBS MS (anatomy), Associate professor, JIIU'S IIMSR, Warudi, Email – swapnabondekar@gmail.com

Second Author – Dr. Priya P. Wattamwar – MBBS MD (anatomy), Assistant professor, JIIU'S IIMSR, Warudi

Third Author – Dr. Azhar A. Siddiqui - MBBS MS (anatomy), Professor and Head JIIU'S IIMSR, Warudi, Email - drazharsiddiqui@gmail.com

Fourth Author – Dr. Hussain R. Zuberi MBBS MS (anatomy), Assistant professor, JIIU'S IIMSR, Warudi

Picture 1: Hemiogenesis of left lobe of thyroid gland



**1 – RIGHT SUBMANDIBULAR
GLAND**

2 – INFRAHYOID MUSCLES

3 – THYROID CARTILAGE

**4 – RIGHT SIDED THYROID
GLAND**

5 – TRACHEA

**6 – RIGHT SUPERIOR THYROID
ARTERY**

7 – INFERIOR THYROID VEIN

A Rare Case of Acromegaly Presenting with Cutis Verticis Gyrata

Dr. R. Nagamani*, **Dr. B.V.S. Ram Prasad****, **Dr. P. Shakuntala** and **Dr. B. V. S. Apoorva*****

*Professor in charge, Dept. of Medicine, Osmania Medical College & Hospital, Hyderabad, 500001, Telangana.

**Consultant Dermatologist, Viswas Medical Center, Hyderabad, Telangana.

*** Asst. Professor of Medicine, Osmania Medical College and Hospital, Hyderabad, Telangana, 500001

**** Intern, Osmania Medical College & Hospital, Hyderabad, 500001, Telangana.

Abstract- The morphologic changes in the scalp which characterizes cutis verticis gyrata was first described by Robert¹ in 1848 and McDowell² and Cown³ in microcephalic idiots.

In 1906 Judassohn⁴ called to the attention of dermatologists the condition was given the name as cutis verticis gyrata by Unna⁵

Fisher stated the belief that true cutis verticis gyrata occurs as a developmental anomaly, probably atavistic in type, representing a reversion to a lower form of life in which the muscles of the scalp could move at will. This is probably the type originally described as present in microcephalic idiots.

Index Terms- Acromegaly, Cutis, Gyrata, Skin, Scalp, Verticis

I. CASE REPORT

We present here a case of young man, who came to our clinic with initial features of thickening of the skin.

An 18 year old male patient, presented with complaints of

- Folds on the forehead since 18 months
- Thickening of the skin of the face since 18 months
- Thickening of the skin over the hands and legs since 18 months

There is no similar history in the family, no history of trauma, fever, hospitalization and medication.

On examination, deep folds of the skin present over the forehead and scalp, with deep groves and thickening of the skin were found to be present.



Figure 1 At Age 16



Figure 2 At Age 18



Figure 3 Thickening of the skin and grooves on scalp

- The patient has coarse facial features, wide nasal bridge and thick palms and soles.

- Clinical diagnosis cutis verticis gyrata was made and the patient underwent investigations.
- Complete Blood Picture – Normal
- Thyroid Profile – Normal
- Growth Hormone Levels -11.1 ng/mL increased
- Random Plasma Glucose – Normal
 - Glycosylated Hemoglobin HbA1c – Normal
- Erythrocyte Sedimentation Rate (ESR) – Normal
- Ultrasound Abdomin and Pelvis – Normal Study
- X-Ray Chest – Normal Study
- X-Ray Skull – AP Lateral View
 - Abnormal thickening of the scalp with increased skin folds showing wavy margin. Thickness about 1 cm - ? Cutis verticis gyrata – For clinical correlation.
 - Mild frontal bossing and angle of the mandible showing thickening with splaying with irregular contour – To rule out mild features of acromegaly..
 - Advised MRI of the brain and contrast enhanced dynamic MRI scan of the pituitary to rule out pituitary adenoma (eosinophilic adenoma)
 - X-Ray both hands PA & Oblique View
 - Bones of both hands well visualized in PA and oblique views.
 - Evidence of soft tissue thickening with spade like terminal tufts noted.
 - Arrow head of distal phalanges of both thumb fingers noted.
 - Slight widening of the joint spaces due to over growth of articular cartilage.
 - Carpal bones of both wrist joint well visualized and normal.
 - Evidence of periosteal reaction of the left 3rd and 4th metacarpal noted.
 - Evidence of cortical thickening/localized periosteal reaction of the proximal phalanges of the 2nd, 3rd and 4th noted in oblique view radiograph.
 - Features suggestive of hyperpituitarism.
 - Advised MRI of the brain and contrast enhanced dynamic MRI scan of the pituitary to rule out pituitary eosinophilic adenoma.
- X-Ray both feet, lateral view
 - Alignment and bone density normal
 - Articular margins, joint spaces normal.
 - No evidence of lytic/sclerotic lesions
 - Evidence of increased thickness of the heel pad which is around 2 cm but it is not recorded as a sign of acromegaly.
 - Evidence of cortical thickening of the lower 3rd of tibia and fibula noted.
- MRI Brain

19.05.2014

- No significant anomaly seen in the brain
- Bilateral mastoiditis is seen with patchy mucosal disease in the paranasal sinuses.
- Note is also made of the increased thickness of the skin of the scalp region.

II. DISCUSSION

Cutis verticis gyrata is a problem mostly found in men. It is about five or six men for one woman.

Possible case of cutis verticis gyrata in this case of acromegaly with excess growth hormone.

The patient was very muscular and considered well built. Patient had features, indicating acromegaly, broadening of his facial features. An examination revealed gyriform oblong skin folds in the fronto parietal region.

Primary CVG, a syndrome occurring almost exclusively in males, has been associated with mental deficiency (the IQ is never greater than 35), cerebral palsy, seizures and ophthalmological abnormalities. It is present in 0.5% of the retarded population in Sweden, Scotland and the USA. There is no evidence for an endocrine influence in primary CVG. Pachydermoperiostosis has often been confused with primary CVG, but this affects not only the skin of the scalp but also the skin of the face, hands and feet; in addition there are accompanying periosteal features. Secondary CVG, has been associated with local disorders of the scalp, most commonly inflammatory conditions such as eczema and psoriasis and with hypertrophy and folding of the scalp as a result of congenital naevi, acromegaly, amyloidosis, and acute myeloid leukaemia. It is treated by surgical reduction of the affected area and results are good. The approach to a patient with CVG should include not only a detailed clinical examination but also a scalp biopsy if an underlying naevoid disorder is suspected.

REFERENCES

- [1] Robert: J. de chir. 1:125, 1848.
- [2] McDowell, T. W.: J. Ment. Sc. 34:62.1863.
- [3] Cowan, J.J.: J. Ment. Sc. 34:539, 1893.
- [4] Jadassohn, J. : Verhandl. D. deutsch.dermat.Gesellsch. 9:451, 1906.
- [5] Unna, PG, Cutis verticis gyrate, Monatsche Pract Dermosol,1907;45:227-33
- [6] Diven DG, Tanus T, Raimer SS, Cutis verticis gyrata, Int J Dermatol 1991;30:710-12
- [7] Akesson HO Cutis verticis gyrate and mental deficiency in Sweden, II Genetic aspects
- [8] MacGillvray RC. Cutis verticis gyrate and mental retardation. Scot Med J 1967;12:450-6
- [9] Paulson GW, Cutis verticis gyrate and Lennox syndrome. Devel Med Child Neurol 1974;16:196-200
- [10] Abu-Jamara F, Dimick DF. Cutis verticis gyrate (a case report of a case secondary to acromegaly treated with plastic surgery and X-Ray therapy). Am J Surg 1966;111:274-7
- [11] Passarini B, Neri L, Patrizi A, Masina M. Cutis verticis gyrate secondary to acute monoblastic leukaemia

AUTHORS

First Author – Dr. R. Nagamani, Professor in charge, Dept. of Medicine, Osmania Medical College & Hospital, Hyderabad, 500001, Telangana.

Second Author – Dr. B.V.S. Ram Prasad, Consultant Dermatologist, Viswas Medical Center, Hyderabad, Telangana.

Third Author – Dr. P. Shakuntala, Asst. Professor of Medicine, Osmania Medical College and Hospital, Hyderabad, Telangana, 500001

Fourth Author – Dr. B. V. S. Apoorva, Intern, Osmania Medical College & Hospital, Hyderabad, 500001, Telangana.

A Prospective study of functional outcome after posterior cruciate retained total knee replacement

Pavan Kumar Reddy.K*, T.H.Prakashappa*, H.S.Chandrashekar*, M.Ramasubba Reddy

* Department of Orthopedics, Sanjay Gandhi Institute of Trauma & Orthopedics, Bangalore.

Abstract -

OBJECTIVES:-

Prospective evaluation of functional outcome after Total knee Replacement using Knee Society score (Insall 1989).

MATERIALS & METHODS:-

50 patients with knee arthritis, 22 female & 28 male, mean age 64(45-80) assigned for TKR at department of orthopedic, Sanjay Gandhi Institute of Trauma & Orthopedic hospital, Bangalore. All patients were evaluated pre operatively & post operatively at 6 months, 12 months, 2 years with knee society clinical & functional score.

RESULTS:-

81% of our patients scored 85 points or better for a rating of excellent by knee society scoring system. 90% patients had little /no pain post operatively, whereas walking ability improved & was unlimited in 80% of the patients post operatively. Knee society clinical & functional score improved from 49 to 89 & 43 to 75 respectively. Average alignment of prosthesis was 5.9 degrees valgus. 81.5% -excellent, 14.85% -good, 3.7% -fair results. Poor results were not seen in any patient.

CONCLUSION:-

T.K.R provided excellent pain relief, adequate stability, remarkable range of motion in severely painful, refractory unstable knees. A significant improvement was seen at two year follow up ..

Index Terms- functional outcome, knee society score, total knee replacement, significant improvement

I. INTRODUCTION

Degenerative diseases like osteoarthritis knee leads to painful, unstable joint with decrease range of motion.¹ 40% of people over 70 years suffer from Knee Osteoarthritis (OA), 80% of OA patients have some degree of movement limitation. Women have more incidence than men. In osteoarthritis knee pain & instability in knees is greatly accentuated under certain circumstances like injury, loads, infection, Central Nervous System diseases and becomes extremely disabling.

Prosthetic replacement of the condylar articular surfaces is an established procedure and is the definitive treatment for osteoarthritis knee². Total knee arthroplasty in osteoarthritis while preserving motion, provides stability¹. There is need to evaluate functional results of total knee arthroplasty in knee joint disorders in Indian. The objectives of the current study are 1) To evaluate the efficacy of total knee replacement in terms of pain relief, range of motion and stability of the joint. 2) To study various complications of total knee replacement

II. MATERIALS AND METHODS

Our study was done in the department of Orthopedics, Sanjay Gandhi Institute of Trauma & Orthopedics, Bangalore. A total of 50 patients (M-28, F-22, with mean age of 61 years) who were admitted in our institute for the management of knee arthritis (osteoarthritis, rheumatoid arthritis etc.) between June 2012 to June 2014 were considered for the study. Patients who had met specific inclusion & exclusion criteria were enrolled in our study.

Inclusion criteria³:-

Age : > 45 years, Gender : Both, Primary osteoarthritis of knee:-- Severe Pain with or without significant deformity, deformity can become the principal indication in patients with moderate arthritis & flexion contractures >20 degrees, hampering gait significantly. Osteoarthritis of knee secondary to : rheumatoid arthritis, systemic arthritis with multiple joint involvement, crystal deposition diseases like gout & pseudo gout in elderly patient, primary synovial conditions such as osteochondromatosis and pigmented villonodular synovitis, juvenile rheumatoid arthritis, osteonecrosis with sub chondral collapse of femoral condyle, and post traumatic arthritis, patients with failure of a high tibial or supracondylar osteotomy are also candidates for total knee replacement.

Exclusion criteria³:-

Inability or unwillingness to comply with postoperative rehabilitation or follow up protocols, active knee infection, substantial neurological or musculoskeletal disorders that would adversely affect gait or early weight bearing after surgery. Extensor mechanism discontinuity/severe dysfunction. Genu recurvatum deformity secondary to muscle weakness. Psoriasis within operative field. Atherosclerotic diseases of operative leg. Venous stasis diseases with recurrent cellulitis.

The individuals presenting with osteoarthritis of knees were approached about the study participation. Once the patients agreed to participate, informed consent was taken & the subjects were then included in the study. All documentation was performed using a standard set of proforma questionnaires (according to Knee society clinical & functional scoring)⁴. All patients underwent operative treatment with Total knee replacement (Exatech, posterior cruciate retained implants). In all patients midline skin incision was given & joint opened through median para patellar approach³. Standard total knee replacement protocol was followed during the surgery. Average operation time was 01hr.45 min. post operative rehabilitation was done as per standard protocol³. Average stay in the hospital was 10 days. All patients were given post operative injection clexane 40mg subcutaneously for 10 days & tablet. Ecosprin for the next 4 weeks⁹. All patients

were evaluated pre operatively & post operatively(6 months,12months,2 years)with knee society clinical score and knee society functional score(Insall 1989)⁴. Our study was an observational prospective orthopedic study.

Statistical Methods:

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. The following assumptions on data are made: **Assumptions:** 1. Dependent variables should be normally distributed 2. Cases of the samples should be independent.

. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale .

Significant figures :-

- + Suggestive significance (p value: 0.05<p<0.10)
- * Moderately significant (p value: 0.01<p≤ 0.05)
- ** Strongly significant (p value: p≤0.01)

III .RESULTS.

Out of 50 patients, 4 patients underwent bilateral TKR (Total **54**). The main indication for TKR was Osteoarthritis(O.A) (40 patients) followed by Rheumatoid Arthritis (**6** patients) ,2 with O.A secondary to pseudo gout& 2 patients with O.A secondary to septic arthritis knee. The follow up period ranged from 1 month to 2 years. Ninety percent of patients had little or no pain postoperatively, whereas 99% of the knees had moderate to disabling pain preoperatively . Walking ability similarly improved and was unlimited in 80% of the patients post operatively . Pre operatively Genu varus deformity was present in **10** patients, maximum varus correction being done was **25°**, Genu valgum deformity in **4** patients, fixed flexion deformity in **14** patients with maximum correction being done was **40°**.Knee instability was present in **20** patients and extension lag in 14 patients. The mean preoperative knee clinical score was **47.56** which improved to **84.33** after T.K.R operation. The mean pre operative functional score was **46.52** which improved to **80.81** post operatively.

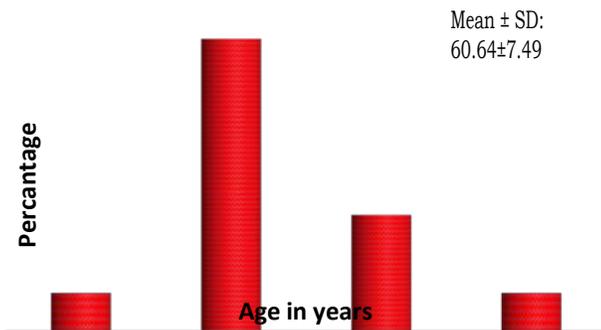


Fig.1 Age distribution of patients studied

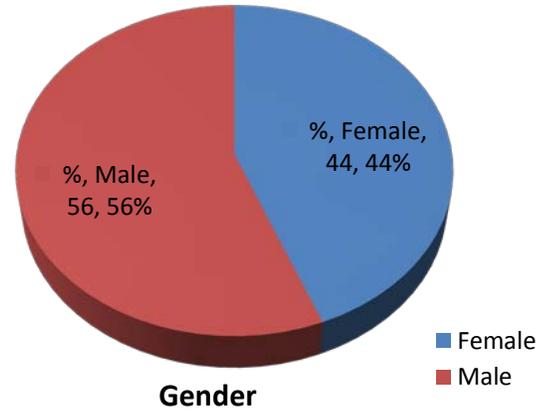


Fig.2 Gender distribution among study group

Tab.1 Diagnosis of patients among group

Diagnosis	%
O-A Knee	77.8
O-A Knee 2 ⁰ to pseudo gout(b/l T.K.R in 2 patients)	7.4
O.A knee 2 ⁰ to septic arthritis	3.7
Rheumatoid arthritis	11.1
Total	100

Tab.2 preoperative deformities among study group

Pre op deformity	%
Nil	48.1
Fixed flexion deformity	29.6
Varus deformity	14.8
Valgus deformity	7.4
Total	100

Table 3: Knee society Clinical score among study group

Knee society Clinical score	Pre op(%)	Post op(%)	% change
<60	100	0	100.00%
60-69	0	7.4	7.40%
70-79	0	14.8	14.80%
80-100	0	77.7	77.7%
Total	100	100	-



Fig.3 Graphical comparison of preoperative & post operative knee society clinical score

Table 4 : Knee society Functional score among study group

Knee society Functional score	Pre op(%)	Post op(%)	% change
<60	100	0	-100.00%
60-69	0	7.4	7.40%
70-79	0	14.8	14.80%
80-100	0	77.8	77.80%
Total	100	100	-

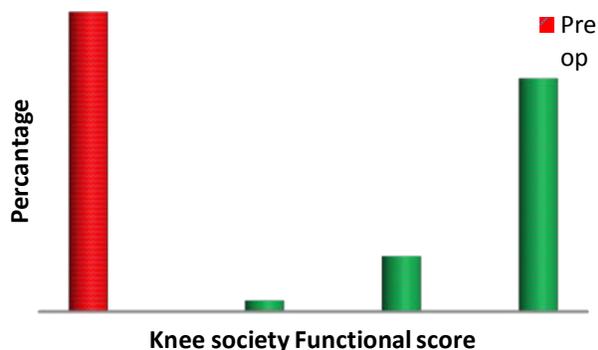


Fig.4 Graphical comparison of knee society functional score preoperatively and post operatively.

In 77.8% of patients no post operative complications were seen .Among the remaining patients 11.1% had post operative stiffness ,7.4% had post operative extensor lag,3.7% had post operative infection. No evidence of Deep Vein Thrombosis/pulmonary embolism, periprosthetic fractures, neurovascular complications^{10,11,12} .On radiological examination, over all alignment⁵ averaged 5.9⁰ valgus, mean femoral angle was 95⁰ and mean tibial angle 90⁰. Mean femoral flexion was 12⁰. Mean lateral tibial angle 87.5⁰ ⁶

Table.5 post operative complications in our study group

Complications	%
No	77.8
Yes	22.2
Post op extension lag-10 degrees	7.4
Post op infection	3.7
Post op knee stiffness	11.1

No radiolucencies were seen after two year follow up⁸. Our study reveals , post operatively 77.8% patients had excellent, 14.8% patients had good and 7.4% patients had fair results clinically & functionally . There were no poor results. There was one patient with post operative infection to operated knee ,we did debridement of the affected knee. Later patient has developed severe knee stiffness, pain during walking.Complications like deep vein thrombosis were absent due to thromboprophylaxis with Inj .Clexane 40mg SC. for at least one week postoperatively followed by Tablet .Ecosprin 75-300mg once a day for 4 – 6 weeks ⁹.Other complications like vascular injuries , skin necrosis, thromboembolism, fat embolism, joint instability, patellar fractures , peri prosthetic fractures were absent.^{10,11,12}

IV . DISCUSSION

The posterior cruciate retained knee prosthesis has enjoyed a proven track record of excellent results in total knee arthroplasty⁷. The posterior cruciate retaining knee design was developed to improve stair climbing ability, range of motion and to prevent posterior subluxation..The range of motion of the knees with a posterior retained design was improved from average from average 90⁰ to 110⁰ ⁷. This impression is further documented by the fact that 77.8% of our patients scored 80 points or better for a rating of excellent by knee society scoring system.

99% of the knees had moderate to disabling pain preoperatively, after total knee replacement 90% of patients had little or no pain postoperatively. Walking ability similarly improved and was unlimited in 80% of the patients postoperatively. The posterior cruciate retained implant has resulted in substantial improvement over the preoperative range of motion (an average of 19⁰).One of the significant factors in the relative universal success of any knee design is better instrumentation developed to help the surgeon achieve acceptable alignment⁵. It was a consideration around 1979-80 that the ideal alignment of prosthesis should be 0⁰, a relative varus alignment⁵. But it has been well proved that the ideal alignment should be between 5⁰-10⁰ of valgus by Insall and Burstein et al in 1978 ⁵. In this study the overall average alignment of prosthesis was 5.9⁰ valgus. Short, localized, standing films, while better than supine radiography, do not always depict an accurate limb alignment, nor allow an absolute correlation to normal gait⁶. The importance of long leg radiography and their relationship to the mechanical axis has been repeatedly reinforced⁸. It has generally been recognized that

the patella should routinely be resurfaced in rheumatoid arthritis; the practice of replacing it in osteoarthritic patient is still somewhat controversial. In this study all most all patients with osteoarthritis, rheumatoid arthritis & pseudo gout underwent patellar resurfacing. The success of total knee arthroplasty depends not only on surgical technique, prosthesis and material design but also on patient selection and a good rehabilitation programme³ In this study the goals of the rehabilitation were:

- Prevention of hazards of bed rest like deep vein thrombosis, pulmonary embolism, pressure ulcers etc.,
- To achieve adequate and functional range of movement
- To train in functional daily living activities.

A rehabilitation specialist involved in preoperative planning and patient selection can influence the outcome of the surgery. In our study we carried out extensive preoperative patient selection and planning with postoperative preoperative rehabilitation programme to achieve above mentioned goals which resulted in **77.8%** excellent results according to the knee society clinical and functional scoring system. Our study is compared to other studies conducted by Christopher, Callahan et al, Martin, Richard Fitch et al & our study has shown same results. pre operative clinical score was 47.56 which improved post operatively to 84.33

Total pain, range of motion, stability score.(clinical score)

Study	Pre-op mean	Postop mean
Our study	47.56	84.33
Fitch et al(2014) ^[13]	46	84
Richard.scott(2006) ^[14]	48	86
Martin et al(1997)	51	89
Callahan et al	40	80
(J arthroplasty 1995) ^[15]	45	89
Christopher(1994) ^[16]		
Krray et al (1991)	32	93
Rand (1991) ^[17]	32	84

Total functional score (knee society functional score) preoperatively it was **46.52** which improved to **80.81** post operatively.

Study	Pre-op mean	Postop mean
Our study	46.52	80.81
Fitch(2014) ^[13]	48	87
Richard(2006) ^[14]	44	82
Martin et al(1997)	49	72
Study	Preop mean	Post op mean
Callahan et al	38	79
(J arthroplasty 1995) ^[15]	42	78
Christopher(1994) ^[16]		
Krray et al (1991)	47	79
Rand (1991) ^[17]	49	86

V . CONCLUSION

Total knee arthroplasty have in the past four decades revolutionized the treatment of osteoarthritic and rheumatoid knee& other arthritic knees. With these excellent results we conclude that total knee arthroplasty provided total relief, adequate stability, remarkable range of motion in severely painful, refractory unstable knees, if performed taking into consideration pre-operation selection of patients, intra operative soft tissue balancing, correct overall alignment of prosthesis and postoperative proper rehabilitation of patients.

We are slowly entering into a generation where we would have to “Revise the Revision” which would pose the greatest of all the challenges to the institution of joint replacement. It is but certain the difficulties about to be faced would generate even more than ever research and development in this field, perpetuating the benefits of this wondrous surgery.

Total knee arthroplasty is a relatively safe and sure procedure in the hands of the experienced or the guided. It forms the integral part of the general orthopedic set up and with proper patient selection, proper procedure and rehabilitation could continue to achieve the same promises as we have seen it to show.

References

- 1) Adam R. F, Noble J. Primary total knee arthroplasty in the elderly, J. Arthroplasty 9 : 495, 1994.
- 2) Ranawat AS .The history of T.K.A in Bonnin MAA, Bellemans j.ed. The knee joint paris springer verlog; 2012:699-707
- 3) Terry Canale S., “Cambell’s Operative Orthopaedics” Mosby, Missouri, 12th Ed., Vol. 1 : 2011, 382-407.
- 4) Bagen J. H, Blaha J.D. Freeman MAR: Alignment in total knee arthroplasty, Clin Orthop 173 : 178, 1983.
- 5) Few M., Waugh W: Tibiofemoral alignment and the results of knee replcement, JBJS 67-B:551, 1995
- 6) Insall JN Dorr LD, Scot RD et al., The rational of knee society clinical rating system Clin. Orthop., 248 : 13, 1989.
- 7) Ewald FC the knee society total knee arthroplasty roentgenographic evaluation and scoring system. Clin Orthop 248 : 9, 1989
- 8) Zelle et al clinic bio mech (Bristol) 2009 dec :24 (10) 842-90 bio mechanical analysis of P.C.R high flexion T.K.R.
- 9) Doouss TW : The clinical significance of venous thromobosis of the calf, J. Bone Joint Surg, 63-B: 377, 1976.
- 10) Fauno P, Sumalainen AO, Rehnberg V, et al: Prophylaxis for the prevention of venous thromobembolism after total knee arthroplasty J. Bone joint surg, 76-A : 1814, 1994
- 11) Aaron P.K., Scott R, supracondylar fracture of the femur after total knee, arthroplasty, clin, orthop., 219 : 136, 1987.
- 12) Clup RW., Schmidt RG Hanks G et al Supracondylar fracture of the femur following prosthetic knee arthroplasty, Clin Orthop., 222 : 212, 1987.
- 13) Fitch D A et al a meta analysis to determine clinical outcomes for a medial pivot total knee replacement. bone joint re. 2014 oct ;3(10):297-304
- 14) Richard D. Scott 1-42:2006 Total knee arthroplasty

- 15) Callahan C. M., Drake BG Heck D.A et al: Patient outcome following unicompartmental or bicompartamental knee arthroplasty: a meta analysis, J Arthroplasty 10 : 141, 1995.
- 16) Ewald FC the knee society total knee arthroplasty roentgenographic evaluation and scoring system. Clin Orthop 248 : 9, 1989
- 17) Rand J.IIstrup DM: Surviorship analysis of total knee arthroplasty, JBJS,73-A: 397, 1991

ACKNOWLEDGMENT

I HEART FULLY THANK OUR DIRECTOR, OUR STAFF ,MY COLLEAGUES, MY PARENTS, MY WIFE & MY BROTHER FOR SUPPORTING IN MAKING THIS POSSIBLE.

First author:-Dr.Pavan Kumar Reddy.k ,
Junior resident, department of orthopedics,
Sanjay Gandhi institute of trauma &
orthopedics(S.G.I.T.O),pavan.kmc2k6@gmail.com

Secondauthor:- Dr.T.H.Prakashappa
professor ,department of orthopedics,S.G.I.T.O

Thirdauthor:- Dr.H.S.Chandrashekar
Professor & H.O.D department of orthopedics,
,S.G.I.T.O.

Fourthauthor:- M.Ramasubba Reddy
assistant Professor,department of orthopedics
S.G.I.T.O.

Correspondence author:-Dr.Pavan kumar reddy . k ,
Junior resident ,Sanjay Gandhi institute of trauma &
orthopedics(S.G.I.T.O),pavan.kmc2k6@gmail.com

Contact number:-9741751693

Study on traditional worshiping plants in Hindu religion from Nalbari and Sonitpur districts of Assam

Jintu Sarma* and Ashalata Devi**

* Ecology and Biodiversity Lab., Department of Environmental Science, Tezpur University, Tezpur, Assam-784028, India, jsarma88@gmail.com

** Ecology and Biodiversity Lab., Department of Environmental Science, Tezpur University, Tezpur, Assam-784028, India, kh_asha@tezu.ernet.in

Abstract- Biodiversity is an important gift of nature that provides all basic requirements for human existence. But due to modern development of human races nature is under great threat. Since time immemorial plants have played an important role in human civilization. It has been observed that large numbers of plants are being used for the worshiping of gods and goddesses by different indigenous communities, which serve as a useful tool for conservation of plants. Hinduism has been called the oldest religion in the world and dominant in Indian subcontinent. The present paper analyzed different plant species that are used in worshiping of gods and goddesses in Hindu tradition in two districts of Assam viz. Nalbari and Sonitpur. A total of 54 species under 51 genera and 30 families were recorded during the study. Among these, *Cynodon dactylon*, *Aegle marmelos*, *Ocimum sanctum*, *Piper betle*, etc. are exclusively used in all worship. Prasad is one of the most important elements of all worship which is prepared with different varieties of fruits and cereals. *Vigna radiate*, *Cicer arietinum*, *Mangifera indica*, *Musa* sp., *Saccharum officinarum*, *Cocos nucifera*, *Zingiber officinale*, etc. are some important species used for the preparation of Prasad. In fact, the Prasad are rich in nutrients and considered very healthy.

Index Terms- Plants, Worship, Hindu, Sonitpur and Nalbari, Assam.

I. INTRODUCTION

The Hindu is one of the largest and oldest religions in the globe. Traditionally Hindu peoples use a large numbers of plant species for worshiping different gods and goddesses. The importance of plants for worshiping god and goddesses has been described in different bedas and it could be seen in the hymns. In India amongst Hindu many plant species are associated with religious function, rituals and also in celebration of festival. Such useful plants have been recorded in the religious book and knowledge has been transmitted from generation to generation. Assam is a state having more than 33 castes with Hindu religion. Brahma et al. [1] described 48 plant species used in socio-cultural and religious practices used by Bodo tribes of BTC, Assam, India. Bhatla et al. [2] highlighted importance of some plants known to be traditionally worshipped in different part of India and its significance. Each cast has some different beliefs and tradition regarding worshiping of gods and goddesses. The Hindu religious peoples are very much concern about the use of plants for each and every occasion from birth to funeral ceremony. But, despite of having such traditional ceremony literatures regarding this Hindu beliefs and worship is insignificant and proper scientific study in this area is very poor. Thus, the present paper attempts to emphasis on the use of plants in some common Hindu traditional worship involved in different socio-religious practices such as, upanayan (traditional ritual ceremony of Hindus for wearing sacred thread), sradha, marriage, common worship of gods and goddesses like lord Vishnu, Laxmi, Kali, Durga, Saraswati, Ganesh, Krishna, Siva, etc. of Nalbari and Sonitpur districts of Assam.

II. MATERIALS AND METHOD

Study on documentation of plant species that are used in different traditional worship among Hindu community of Nalbari and Sonitpur districts was carried out during 2013 to 2014. Different traditional Hindu socio-religious occasions and information's of plant species used in different pujas, socio-religious ceremony or festival were recorded. Importance of the plant species, uses of plant parts in traditional practices, beliefs and benefits were collected through semi structured personal interview with the specialized persons like priests, who performed different ceremonies and rituals, and some knowledgeable old persons who are involved in different religious practices. Due to inadequate references authors attended different occasions to collect relevant data. Photographs of different worships involved during different occasions like, marriage, dead anniversary (sradhas) and some other worship are taken from different places for record of evidence. The collected plant specimens were carefully identified with the help of relevant scientific literatures [3]. Finally, the specimens are deposited in the Ecology and Biodiversity Lab., Herbarium Unit of the Dept. of Environmental Science, Tezpur University, Assam.

III. RESULTS AND DISCUSSION

A total numbers of 54 plant species under 51 genera and 30 families were reported from the present study. In Hindu tradition, it has been believed that different gods and goddesses have some specific character and they love different plant depending upon their colour, fragrant, etc [4]. *Aegle marmelos* locally called belboron is used to worship lord Siva (**Figure 1, A**) it is also believed that lord Siva rest under *Aegle marmelos* tree, *Oryza sativa* is believed as the plant of goddesses Laxmi and it is believed that lord Krishna love *Anthocephalus cadamba*. Sradha is one of the important Hindu religious practices held before all the occasions to worship the ancestors. *Musa* sp., *Areca catechu*, *Desmostachya bipinnata*, *Mangifera indica*, *Cynodon dactylon*, *Ocimum sanctum* and different other flowers are used in this form of worship (**Figure 1, B**).

In Hindu marriage ceremony the brides and grooms are sanctify taking bath with turmeric (*Curcuma longa*), black gram (*Vigna mungo*), etc. under banana plant (**Figure 1, C**). Generally in Hindu marriage ceremony a very special drawing (Rangoli) has been prepared using the powders of *Bixa orellana* seeds, *Aegle marmelos* leaves, *Curcuma longa* rhizomes, etc. (**Figure 1, D**). This Rangoli depicts the sacred welcoming areas for the Hindu deities and thought to bring good luck. The worship of Lord Agni (fire) is common in Hindu tradition. In Hindu marriage ceremony it has been seen that bride and grooms takes oath in front of Lord Agni and during the worship whole plant of dry *Desmostachya bipinnata*, dry woods of *Mangifera indica* and *Prosopis cineraria* are used (**Figure 1, E**). Twig of *Mangifera indica* plant with 5 or 7 leaves are kept in earthen pot with water and used for all worship (**Figure 1, F**). *Prosopis cinerarium* is also used to worship the lord Agni (fire) in the ritual ceremony of Mundan (Surhakaran) and upanayan. *Prosopis cinerarium* is a very rare species in natural abundance. Now a days, due its unavailability most of the Hindu peoples are planting this species in their home to fulfil the need for worshipping. Ashok plant (*Saraca asoca*) is very important for Hindus and is worshipped on a very special occasion Ashok astami.

It was recorded that during goddess Durga puja the very first day there is a tradition to worship the *Aegle marmelos* and it has been believed that goddess Durga comes from this plant and take her sacred place of worship and on the day of Vijayadashami Aparajita (*Clitoria ternatea*) is worshiped. Kusha (*Desmostachya bipinnata*) is commonly used as floor mat to seat on during all the worshipping and other holy occasions. *Musa* sp. is very important plant and all parts of the plant are widely used during all form of Hindu worship. Each and every part of *Musa* sp. is important from worship point of view. *Aegle marmelos* (**Figure 1, G**), *Ocimum sanctum* and *Cinodon dactylon* are three integral part of worshipping of all gods and goddesses. Without this three species no worship takes place or not complete. There are some species related to some particular god and goddesses. While, *Areca catechu* and *Piper betle* are two most important component of each and every ceremony (**Figure 1, H**). *Alocasia macrorrhiza*, *Euphorbia nerifolia*, *Mimusops elengi*, *Benincasa hispida* are some plant species used for worshipping goddesses Kali. *Ficus glomerata* and *Ficus benghalensis* are used in worshipping Lord Vishnu. Details of the recorded 54 plant species in terms of their vernacular name, scientific name, family, life form and their uses are given in **Table 1**.

Table 1: List of plants used for worshipping of gods and goddesses in different socio-religious practices of Hindu tradition with reference to Nalbari and Sonitpur district of Assam.

Sl.no.	Vernacular name (Assamese)	Botanical name	Family	Habit	Part used	Use
1.	Bel	<i>Aegle marmelos</i> (L.) Corrêa	Rutaceae	Tree	Whole plant	All worship
2.	Man kochu	<i>Alocasia macrorrhiza</i> (L.) G. Don	Araceae	Herb	Whole plant	Kali Puja
3.	Kadam	<i>Anthocephalus cadamba</i> (Roxb.) Miq.	Rubiaceae	Tree	Whole plant	Worshipping of Lord Krishna
4.	Tamol	<i>Areca catechu</i> L.	Arecaceae	Tree	Fruit	Basically in all occasion
5.	Kothal	<i>Artocarpus heterophyllus</i> Lam.	Moraceae	Tree	Leaf twig and fruit	All worship
6.	Naal	<i>Arundo donax</i> L.	Poaceae	Grass	Whole plant	In some specific occasion
7.	Baah	<i>Bambusa</i> sp.	Poaceae	Herb	Whole plant	All worship
8.	Bogakomora	<i>Benincasa hispida</i> (Thunb.) Cogn.	Cucurbitaceae	Climber	Fruit	Specially in Goddess Kali puja
9.	Sendur	<i>Bixa orellana</i> L.	Bixaceae	Tree	Seeds	All worship
10.	Dhuna	<i>Boswellia serrate</i> Roxb. Ex Colebr.	Bursaceae	Tree	Resin	All worship
11.	Kola Sarioh	<i>Brassica rapa</i> L.	Brassicaceae	Shrub	Seeds	To remove devil sprit
12.	Bhang	<i>Cannabis sativa</i> L.	Cannabaceae	Shrub	Fruit	Worship of Lord Siva
13.	Nayantora	<i>Catharanthus roseus</i> (L.) G. Don	Apocynaceae	Shrub	Flower	All worship
14.	Nemu	<i>Citrus indica</i> Yu. Tanaka	Rutaceae	Shrub	Fruit	Durga puja

15.	Aparajita	<i>Clitoria ternatea</i> L.	Leguminosae	Climber	Flower and Whole plant	Specially in Aparajita puja during Durga puja
16.	Narikol	<i>Cocos nucifera</i> L.	Arecaceae	Tree	Fruit	All worship
17.	Halodhi	<i>Curcuma longa</i> L.	Zingiberaceae	Herb	Rhizome	All worship
18.	Durba	<i>Cynodon dactylon</i> (L.)Pers.	Poaceae	Grass	Whole plant	All worship
19.	Dhatura	<i>Datura metel</i> L.	Malvaceae	Shrub	Flower	Worship of Lord Siva
20.	Kusha ban	<i>Desmostachya bipinnata</i> (L.) Stapf	Poaceae	Herb	Whole plant	All worship
21.	Rudrakshya	<i>Elaeocarpus serratus</i> L.	Elaeocarpaceae	Tree	Fruit	Worship of Lord Siva
22.	Siju	<i>Euphorbia nerifolia</i> L.	Euphorbiaceae	Shrub	Whole plant	During Bathu Puja
23.	Baatgoch	<i>Ficus benghalensis</i> L.	Moraceae	Tree	Leaf and twig	During Lord Bishnu Puja and some other pujas
24.	Gagyadimoru	<i>Ficus glomerata</i> Roxb.	Moraceae	Tree	Leaf and twig	Vishnu yagya
25.	Aahot	<i>Ficus religiosa</i> L.	Moraceae	Tree	Leaf and twig	Worship of Lord Agni
26.	Kopah	<i>Gossypium hirsutum</i> L.	Malvaceae	Tree	Flower	Marriage and some other festival
27.	Joba	<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	Tree	Flower	All worship
28.	Aam	<i>Mangifera indica</i> L.	Anacardiaceae	Tree	Leaf, stem and fruit	All worship
29.	Bokul	<i>Mimusops elengi</i> L.	Sapotaceae	Tree	Leaf, twig and flower	Kali puja
30.	Vim Kal	<i>Musa balbisiana</i> Colla	Musaceae	Shrub	Whole plant	All worship
31.	Jaifal	<i>Myristica fragrans</i> Houtt.	Myristicaceae	Tree	Fruit	All worship
32.	Padum	<i>Nelumbo nucifera</i> Gaertn.	Nelumbonaceae	Herb	Leaf and flower	Goddess Laxmi, Durga and some other pujas also
33.	Tulsi	<i>Ocimum sanctum</i> L.	Lamiaceae	Shrub	Whole plant	All worship, Holy plant of Hindu
34.	Dhan	<i>Oriza sativa</i> L.	Poaceae	Grass	Whole plant	Specially during Laxmi Puja
35.	Paan	<i>Piper betle</i> L.	Piperaceae	Climber	Leaf	All worship
36.	Champaphul	<i>Plumeria alba</i> L.	Apocynaceae	Tree	Flower	All worship
37.	Samidh	<i>Prosopis cineraria</i> (L.) Druce	Leguminosae	Tree	Stem	Mundan, Upanayan, Marriage ceremony, different yagya puja's.
38.	Raktachandan	<i>Pterocarpus santalinus</i> L.f.	Leguminosae	Tree	Stem	Lord Siva puja, Durga Puja and some other puja.
39.	Dalim	<i>Punica granatum</i> L.	Lythraceae	Shrub	Fruit and leaf	Durga puja
40.	Golap	<i>Rosa</i> sp.	Rosaceae	Shrub	Flower	All worship
41.	Kuhiyar	<i>Saccharum officinarum</i> L.	Poaceae	Shrub	Whole plant	All worship
42.	Boga Chandan	<i>Santalum album</i> L.	Santalaceae	Tree	Stem	All worship
43.	Ashok	<i>Saraca asoca</i> (Roxb.) Willd.	Leguminosae	Tree	Flower	Specially in Ashokastami during Durga puja
44.	Til	<i>Sesamum indicum</i> L.	Pedaliaceae	Shrub	Fruit	All worship
45.	Bogasarioh	<i>Sinapis alba</i> L.	Brassicaceae	Herb	Seeds	All worship
46.	Nityaphul	<i>Tabernaemontana divaricata</i> (L.) R.Br. ex Roem. &Schult.	Apocynaceae	Shrub	Flower	All worship

47.	Gendhaphul	<i>Tagetes patula</i> L.	Asteraceae	Shrub	Flower	All worship
48.	Silikha	<i>Terminalia chebula</i> Retz.	Combretaceae	Tree	Fruit	All worship
49.	Makoi	<i>Zea mays</i> L.	Poaceae	Herb	Fruit	All worship
50.	Aada	<i>Zingiber officinale</i> Roscoe	zingiberaceae	Herb	Rhizome	All worship
51.	Bogori	<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	Tree	Fruit , leaf	All worship
52.	Matimah	<i>Vigna mungo</i> (L.) Hepper	Leguminosae	Herb	Seed	Hindu marriage
53.	Mug	<i>Vigna radiate</i> (L.) R.Wilczek	Leguminosae	Herb	Seed	All worship
54.	But mah	<i>Cicer arietinum</i> L.	Leguminosae	Herb	Seed	All worship

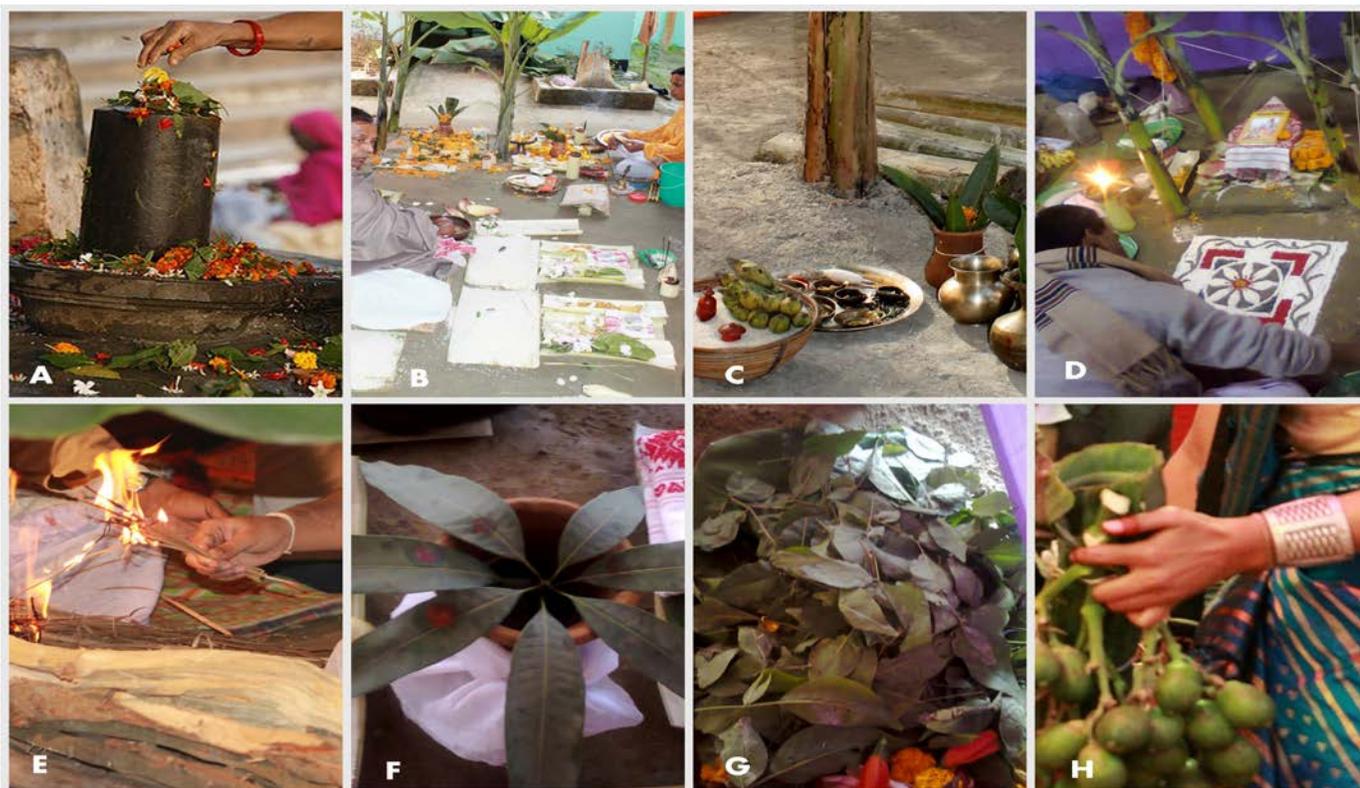


Figure 1: (A) Leaves of *Aegle marmelos* used in the worshipping of Lord Siva; (B) *Musa* sp., *Areca catechu*, *Desmostachya bipinnata*, *Mangifera indica*, *Cynodon dactylon* and different flowers used in *sradh*as to worship the ancestors; (C) *Musa* plant, *Mangifera indica* leaf, *Areca catechu* arrange to bath the bride and grooms in marriage ceremony; (D) Patterns created by the priest on the floor using powder of *Bixa orellana*, *Aegle marmelos*, *Curcuma longa*, etc, essential in Hindu marriage ceremony; (E) *Desmostechya bipinnata*, *Mangifera indica* and *Prosopis cineraria* used to worship god fire; (F) Twig of *Mangifera indica* with 5 or 7 leaves are kept in earthen pot and used for all worship; (G) Leaves of *Aegle marmelos* and other flowers ready for worship and (H) Bunch of *Areca catechu* used in marriage ceremony.

IV. CONCLUSION

The study on religious plants used in various Hindu traditional worshipping exhibits the important role of plants in human life. The present study help to understand how Hindu indigenous community of Nalbari and Sonitpur district of Assam are contributing towards the conservation of plants and forest in general of their own interest to safeguard their inherent socio-cultural and religious activities. Such activity of conserving and using plant species in the name of worshipping and socio-cultural beliefs reveal a strong significance in today's concern of biodiversity conservation.

ACKNOWLEDGMENT

The authors are thankful to villagers and religious headmen who are involved in this work for their kind assistance and useful information. Special thanks to Sastri Jatindra Nath Sarma of Kaithalkuchi village of Nalbari district, for his valued assistance throughout the work

REFERENCES

- [1] S. Brahma, H. Narzary , J. Brahma, Socio-cultural and Religious plants used by Bodo tribes of BTC, Assam, India, Int J of Sc and Res Pub., 2014. 4(1): 1-11.
- [2] N. Bhatla, T. Mukerjee , G. Singh, Plants: Traditional worshipping, Indian J of History of Sc., 1984. 19(1): 37-42.
- [3] U.N.Kanjilal et.al., Flora of Assam, Govt. of Assam, Shillong, 1934-1940, Vol 1-4.
- [4] R. Shah , R. Patel, Study of Traditional Worshipping Plant of Borsad Taluka (Gujarat) India, Abhinav, 2012. 1(11) : 69-73.

AUTHORS

First Author – Jintu Sarma, Research Fellow, Ecology and Biodiversity Lab., Department of Environmental Science, Tezpur University, Tezpur, Assam- 784028, India, jsarma88@gmail.com

Second Author – Dr. Ashalata Devi, Assistant Professor, Ecology and Biodiversity Lab., Department of Environmental Science, Tezpur University, Tezpur, Assam-784028, India, kh_asha@tezu.ernet.in

Correspondence Author – Jintu Sarma, Research Fellow, Ecology and Biodiversity Lab., Department of Environmental Science, Tezpur University, Tezpur, Assam- 784028, India, jsarma88@gmail.com

Laparoscopic versus open incisional hernia repair: An institutional experience

Dr. Vijay Koduru*, Prof. Annappa Kudva*, Dr. Ravikiran Naalla*

*Department of General surgery, Kasturba Medical College, Manipal University

Abstract- Laparotomy performed for surgical access usually heals quickly and without complications, leaving a stable scar. An exception to this is the rare (< 1%) occurrence of acute separation of the sutured abdominal walls during the postoperative phase – known as acute wound dehiscence or burst abdomen – and the more frequent (> 20%) occurrence of chronic wound dehiscence with the formation of a hernial sac and canal months to years after surgery. This is known as incisional hernia. Incisional hernia is receiving greater attention in the medical community than in previous years, due to the increasing use of ultrasonography as part of follow-up after abdominal surgery, increased long term survival even after oncological surgery, and demographic developments which permit longer follow up. Incisional hernias and ventral hernias larger than 2 cm are preferably repaired using prosthesis, because primary repair has an unacceptable high rate of recurrences.

Mesh repair has become standard for treatment of hernia now. With evolution of technology and the recent advances in surgery, surgeons started doing laparoscopic repair in 1990's.

The laparoscopic technique is believed to have fewer complications and a better postoperative course, with quicker ambulation, shorter hospital stay and less postoperative pain. Low recurrence rates of 0 to 9% are reported.

With the potential advantages of this minimal invasive approach, we started to perform this technique in our institute from 2008. This study was done to evaluate the results of our initial experience with laparoscopic repair and comparing with open repair of incisional hernia.

Index Terms- Laparoscopic incisional hernia repair, open incisional hernia repair, mesh repair, minimally invasive incisional hernia repair.

I. INTRODUCTION

Incisional hernia has been clinically defined as “a bulge, visible and palpable when the patient is standing, and often requiring support or repair”.

Incidence

Incisional hernia is a common and often debilitating complication after laparotomy. Despite significant advances in many areas of surgery, correction of incisional hernias continues to be problematic, with recurrence rates ranging from 5% to 63% depending on the type of repair used [1]. Recurrence rates are likely underestimated because of a lack of long-term follow up and objective criteria in the literature to determine true

recurrence. It is the most common complication after laparotomy by a 2:1 ratio over bowel obstruction and is the most common indication for reoperation by a 3:1 ratio over adhesive small bowel obstruction.

In a retrospective review of 206 patients who underwent incisional hernia repair, Read and Yoder [2] found that strangulation or incarceration was the indication for repair in 17% of patients. Incisional hernias are the only abdominal wall hernias that are iatrogenic.

PATHOPHYSIOLOGY

Advances in the basic and clinical sciences have allowed a better understanding of the pathophysiology of hernia formation. It is known, for example, based on Pascal's principle of hydrostatic forces and the law of LaPlace, that a hernia will continue to enlarge over time if not treated.

Increased intra-abdominal pressure will exert its greatest force on the portion of the wall that is thinnest. As the hernia enlarges, the wall thins at that point, and the diameter increases. This positive feedback loop virtually assures continued progression.

This is the reason, an incisional hernia is considered an indication for operation as in spite of its size as it eventually enlarges in size over a period of time due to continuous abdominal pressure on repeated straining. These complications will eventually be difficult to manage during an emergency surgery.

PREVENTION

Controversy exists regarding the optimal closure material and technique used to avoid incisional hernias. Carlson and colleagues [3] compared the incisional hernia rate of midline, transverse, and paramedian incisions. Midline incisions had the highest hernia rate of 10.5% compared with 7.5% with transverse incisions and 2.5% with paramedian incisions.

In addition to incision type, the abdominal wall closure method is important for prevention of incisional hernias. A number of meta-analyses have shown that mass closure with a continuous non- or slowly absorbable suture is the best technique for preventing incisional hernias [4].

Although there is no strong evidence from randomized clinical trials, prospective clinical studies and experimental evidence support the use of a suture length : wound length ratio of at least 4:1. To arrive at a closure suture length of four times the incision length, the bites must encompass one centimeter of tissue at one-centimeter intervals. They also found non-absorbable suture in continuous fashion to be the material and technique of choice.

RISK FACTORS & ETIOLOGY

Studies have shown that 50% of hernia recurrences are detected in the first postoperative year, 75% are detected at 2 years, and 90% are detected at 3 years, with continued failure rates of 2% per year thereafter [5].

These findings implicate technical factors in early wound failure and patient-related factors in late wound failure.

Early wound failure – (Technical factors)

Playforth and colleagues [6] applied radiopaque staples to the margins of incised fascia. Serial radiographs were taken at time intervals up to 1 year. In patients who developed incisional hernias at 1 year, there was separation of the staples at 1 week postoperatively. This finding supports faulty surgical technique as the primary cause of early wound failure. Poole [7] concluded in a comprehensive review that local technical factors were of greater significance than patient-related conditions in the development of incisional hernias.

Given these findings, it is incumbent on surgeons to identify and use appropriate techniques and materials to minimize the incidence of incisional hernias.

Perioperative surgical site occurrence (SSO) defined as infection, seroma, wound ischemia, and dehiscence, increases the risk of recurrent hernia by at least 3-fold.

Controversy exists regarding the optimal closure material and technique used to avoid incisional hernias which was briefly discussed earlier under prevention.

Late wound failure – (Patient related factors)

Many patient-related risk factors have been implicated in the development of incisional hernias, including obesity, smoking, aneurismal disease, chronic obstructive pulmonary disease, male gender, malnourishment, corticosteroid dependency, renal failure, malignancy, and prostatism.

Many of these risk factors may contribute to the development of an incisional hernia, but no single factor is so regularly associated that it may be declared as serving a truly etiologic role.

Significant demographic factors influencing incisional hernia incidence were age (> 45 years) and male gender. The preoperative factors, anemia (Hb < 10 gm%) and BMI > 25 Kg/m², the intraoperative factors, recurrent incision and previous laparotomy, and the postoperative factors, catecholamin-therapy and disturbed wound healing were of significant influence in development of incisional hernia.

On multivariate analysis, only the combination of reopening and reclosing previous incisions coupled with wound infection influenced the development of incisional hernia.

Postoperative wound infection has been found in additional studies to be the single most significant prognostic factor in the development of incisional hernia.

Bucknall and colleagues [8] reported a 23% incidence of incisional hernia formation in patients who developed a wound infection.

CLASSIFICATION – EHS

(European Hernia Society) – 2007 [9]

This classification may provide enough information to establish incisional hernia registries and may be used to compare studies on treatment and outcome of incisional hernia repair. It has shortcomings, because of the large diversity and heterogeneity of incisional hernias, but it is a mandatory condition to improve the quality of reporting results in the field of incisional hernia surgery. There was a consensus that the following 2 criteria of incisional hernia are essential for classifying-

- A) Localization of the hernia
- B) Size of hernia defect

The abdomen was divided into a medial or midline zone and a lateral zone.

Medial or midline hernias

The borders of the midline area are defined as:

- (1) cranial: the xyphoid
- (2) caudal: the pubic bone
- (3) lateral: the lateral margin of the rectal sheath

Thus, all incisional hernias between the lateral margins of both rectus muscle sheaths are classified as midline hernias.

An easily memorable classification from M1 to M5 going from the xiphoid to pubic bone was proposed (Figure 1). Therefore, we define 5 M zones:

- (1) M1: subxyphoidal (from the xiphoid till 3 cm caudally)
- (2) M2: epigastric (from 3 cm below the xiphoid till 3 cm above the umbilicus)
- (3) M3: umbilical (from 3 cm above till 3 cm below the umbilicus)
- (4) M4: infraumbilical (from 3 cm below the umbilicus till 3 cm above the pubis)
- (5) M5: suprapubic (from pubic bone till 3 cm cranially).

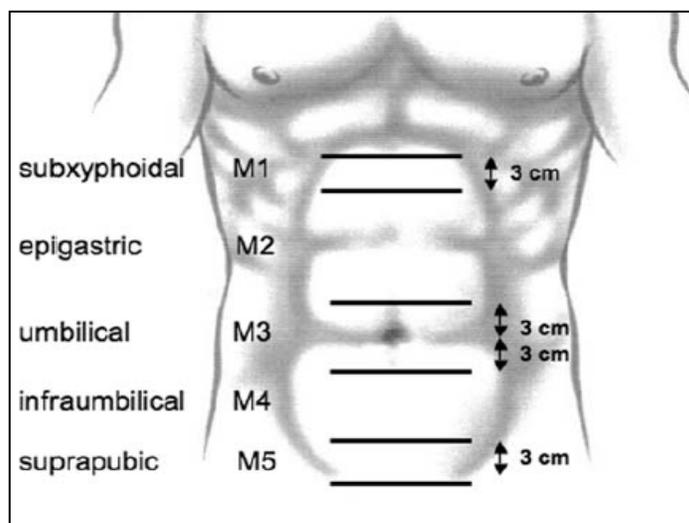


Figure 1 : Classification of midline incisional hernias

Lateral hernias

The borders of the lateral area are defined as (Figure 2).

- (1) cranial: the costal margin
- (2) caudal: the inguinal region
- (3) medially: the lateral margin of the rectal sheath
- (4) laterally: the lumbar region.

Thus, four L zones on each side are defined as:

- (1) L1: subcostal (between the costal margin and a horizontal line 3 cm above the umbilicus)
- (2) L2: flank (lateral to the rectal sheath in the area 3 cm above and below the umbilicus)
- (3) L3: iliac (between a horizontal line 3 cm below the umbilicus and the inguinal region)
- (4) L4: lumbar (latero-dorsal of the anterior axillary line)

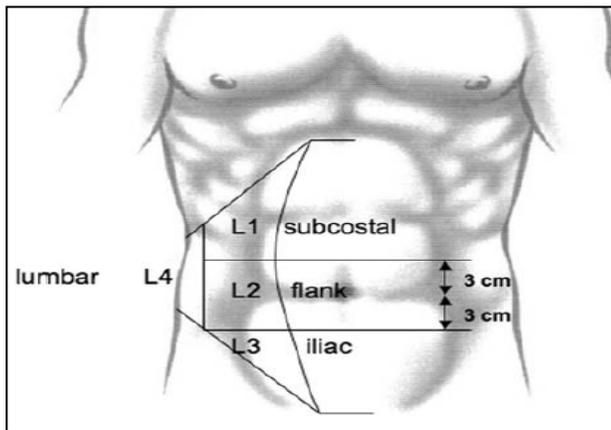


Figure 2 : Classification of lateral incisional hernias

Size of the hernia

In contrast to primary abdominal wall hernias, incisional hernias come in many different sizes and shapes. So the size of an incisional hernia is not easily captured in only one variable or measurement.

Chevreil solved this problem by choosing the width of the hernia defect as the one parameter to classify, stating that the width is the most important measurement of size to determine the difficulty of successfully repairing the hernia.

To avoid confusion with primary abdominal wall hernias (small, medium and large), a coded taxonomy was chosen instead of a nominative one.

- W1 < 4 cm;
- W2 ≥ 4–10 cm;
- W3 ≥ 10 cm

The length of the hernia defect was defined as the greatest vertical distance in cm between the most cranial and the most caudal margin of the hernia defect. In case of multiple hernia defects from one incision, the length is between the cranial margin of the most cranial defect and the caudal margin of the most caudal defect (Figure 3).

Hernia defect surface can be measured by combining width and length in a formula for an oval, thus trying to make an estimation of the real surface in cm². This option was not withheld, because many incisional hernias are not oval shaped,

and many hernias have multiple defects, making the correct estimation of hernia defect size difficult.

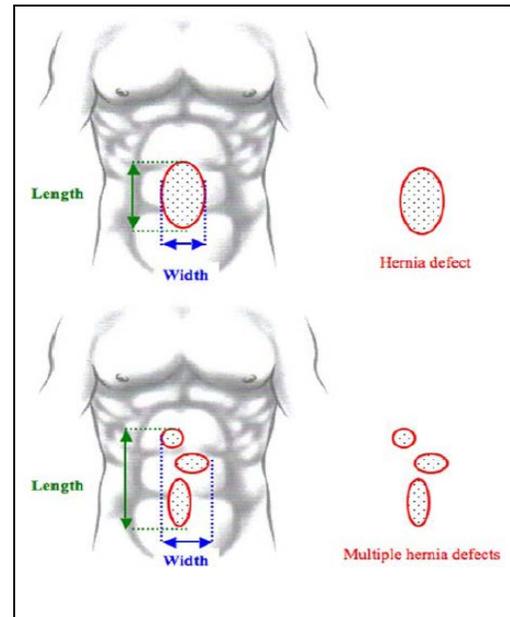


Figure 3 : Definition of the width and the length of incisional hernias for single hernia defects and multiple hernia defects

Table 1 : EHS Classification

EHS			
Incisional Hernia Classification			
Midline	subxiphoidal	M1	
	epigastric	M2	
	umbilical	M3	
	infraumbilical	M4	
	suprapubic	M5	
Lateral	subcostal	L1	
	flank	L2	
	iliac	L3	
	lumbar	L4	
Recurrent incisional hernia?		Yes <input type="radio"/>	No <input type="radio"/>
length:	cm	width:	cm
Width	W1	W2	W3
	<4cm	≥ 4-10cm	≥10cm
cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

SIGNS & SYMPTOMS

Important symptom is bulge, which is located over or near the scar of a ventral abdominal wall incision and enlarges during standing, is the usual clinical presentation. In time, incisional hernias become larger.

In a literature review concerning the natural course of incisional hernia, this lack of information was underscored. According to this review, many incisional hernias (47-88%) are asymptomatic. In this review, strangulation or incarceration in incisional hernias was mentioned as an indication for operation in 6-14.6% of cases. Trophic ulcers were observed in 3.25% of giant incisional hernias (33 out of 1018 cases) [10].

Courtney described the presentation of 60 incisional hernias, of which 82% were primary incisional hernias [11]. The indications for operation in this study were pain in 83%, incarceration in 5% and enlargement in 3% of cases. In 3% of these patients, the indication for operation was not specified.

IMAGING

Sonography is a helpful diagnostic aid, particularly in small or barely palpable hernias, or in obese patients, as it is non-invasive, time and cost-saving, readily repeatable, and practically risk-free.

Besides location and size, ultrasonography allows the determination of hernial content, as well as excluding important differential diagnoses such as lymphoma or hematoma.

Important sonographic criteria for identifying hernias are:

- ✓ detection of a fascial gap (rectus diastasis as differential diagnosis),
- ✓ visualization of hernia content,
- ✓ increase in the volume of the hernial content and canal on Valsalva maneuver
- ✓ most commonly used for identification of early recurrence.

Computerized tomography or magnetic resonance imaging are methods particularly suited for complicated hernias or large abdominal wall defects and enable the visualization of internal hernial sac structures and the entire abdominal wall as well as their relationship to intra-abdominal organs.

TREATMENT & OUTCOME

Controversy exists regarding the ideal treatment of incisional hernias. Nowhere in surgery does the phrase "if there are multiple ways of fixing a problem then there is not one good way" hold true more so than with incisional hernia repair.

The approach to incisional hernia repair is often based on tradition rather than evidence.

In general, an incisional hernia is considered an indication for operation, but some surgeons prefer a wait-and-see policy. Several important principles have been defined to aid in the surgical approach to this difficult problem.

The goals of hernia repair should be as follows:

1. Prevention of visceral eventration
2. Incorporation of the remaining abdominal wall in the repair
3. Provision of dynamic muscular support
4. Restoration of abdominal wall continuity in a tension-free manner.

The surgeon can choose from a number of treatment options, which fall into two principal categories:

- ✓ the conventional suture technique
- ✓ the open or laparoscopic mesh technique.

Surgical technique of open hernia repair –

The open technique may consist of a anatomic repair, simple hernioplasty (e.g., Mayo duplication or fascia adaptation), components separation technique or mesh repair.

The mesh can be placed using

- ✓ Onlay (prefascial/subcutaneous, Sandwich or Chevrel technique),
- ✓ Sublay (retromuscular or preperitoneal) or
- ✓ Inlay ("bridging") techniques.

Open surgical techniques were popularized by Rives, Stoppa and Wantz.

Anatomical Repair :

Small hernial defects usually < 3 cm are closed primarily using non absorbable suture.

Retromuscular / Preperitoneal (Sublay technique) repair :

Rives developed the sublay technique. Medial border of the anterior fascia opened, posterior aspect of rectus muscle dissected to reach lateral border of rectus sheet, bilaterally. Peritoneum and posterior rectus fascia closed with absorbable suture. Polyester or light-weight polypropylene mesh is cut to fit the reconstructed area, to have 3 cm overlap on caudal and cranial defect limits. Mesh is fixed by non-absorbable sutures. Anterior fascia is closed with non-absorbable suture. Components separation upon need was done.

Recent advocates of the technique have claimed that sublay is the ideal position for the mesh, but have not provided evidence from randomized trials.

The disadvantages of the sublay are that it is more technically challenging, requiring the opening of a large space behind the rectus muscles. The sublay method is only applicable to midline hernias and cannot be used in other locations which represent 20% of anterior abdominal wall incisional hernias.

Onlay (Prefascial/Subcutaneous, Sandwich or Chevrel technique) repair:

The onlay technique was originally reported by Chevrel. Fascial defect is closed with interrupted or running non-absorbable suture. Mesh is placed and fixed over the closed rectus defect by using an intermittent non-absorbable suture. Components separation upon need was done.

When the prosthetic material is secured posterior to the abdominal wall musculature in the preperitoneal space or subpreperitoneal space, as described by Stoppa, an increase in intra-abdominal pressure buttresses rather than distracts the repair. Hence, sublay repair is said to be better with less chance of recurrences compared to onlay mesh repair.

Conversion to open surgery

The conversion rate to open surgery depends on the surgeons experience, the surgical skills, and intraoperative complications such as bowel lesions or bleeding.

In the literature conversion to open surgery is mostly due to adhesions, with an overall conversion rate of 10-15% [12]. However, complete adhesiolysis is very important especially in large incisional hernia to gain enough place for the mesh fixation and therefore to minimize the recurrence rate.

Laparoscopic Repair of Incisional Hernia -

The popularity of laparoscopic incisional hernia repair is increasing. The early postoperative adverse events, overall safety, and clinical effectiveness of laparoscopic and open repair are similar.

The laparoscopic approach offers several key advantages over the open approach, including low risks of infection and shortened hospital stay in addition to reductions in complication rates, postoperative pain, and postoperative ileus.

The lower recurrence rates reported with laparoscopy are convincing, although they remain to be demonstrated conclusively. Even lowered overall hospital costs have been associated with laparoscopic hernia repair.

Accessing the abdomen for a laparoscopic hernia repair and performing adhesiolysis does carry a potential risk of injury to intestine, which, if missed, can lead to intra-abdominal sepsis.

Itani and colleagues [13] have reported the rates of bowel injury as 7.2% in open hernia repairs and 9% in laparoscopic procedures. Others have reported that the incidence of bowel injuries differs insignificantly between laparoscopic and open approaches and is low in both approaches.

The bowel actually is easier to identify in laparoscopic surgery than in open surgery, because it generally hangs down, away from the abdominal wall, and insufflation permits better plane definition.

Transfixing sutures typically are used to facilitate close approximation of the prosthetic material to the abdominal wall so adequate ingrowth can occur. Persistent pain at these suture sites is a problem unique to the laparoscopic approach and occurs in 1% to 3% of patients.

In a series by Olmi and colleagues [14] wound complications also were noted to be significantly lower in laparoscopic hernia repairs than in open repairs (1.1% versus 8.2%). The laparoscopic approach diminishes the need to raise large tissue flaps or devitalize tissues, procedures that increase the risk of mesh infection.

Consideration must be given to the use of carbon dioxide as the insufflation agent during laparoscopy. The additional carbon dioxide burden is a contraindication to laparoscopic herniorrhaphy for patients who have severe chronic obstructive pulmonary disease. Because even a relatively modest increase in afterload or decrease in preload would prove problematic, patients who have extremely poor cardiac reserve may be better served by an open approach or watchful waiting.

II. MATERIAL AND METHODS

This study is a prospective observational study, conducted from 15-Nov-2011 to 15-April-2013 including all the patients of incisional hernia operated in Kasturba Hospital, Manipal within the study period fitting into the study requirements according to inclusion and exclusion criteria as mentioned below.

Inclusion Criteria

1. Age: >18 years
2. Uncomplicated incisional hernias reducible hernias only
3. Diagnosed case of incisional hernia (Imaging/Laparoscopy)
4. Medically fit for general anesthesia

Exclusion Criteria

1. Age <18 years
2. Obstructed hernia / Incarcerated hernia
3. Emergency surgery, peritonitis, bowel obstruction, strangulation, perforation
4. Incisional hernia repair accompanied with any other surgical procedure
5. Cases of other ventral hernias (epigastric, umbilical / paraumbilical, spigelian hernias)
6. Ongoing chronic pain syndrome, other than hernia origin
7. Mentally ill patients/Any cognitive impairment (Psychiatric disorder, Alzheimer's disease etc.)
8. Presence of local or systemic infection.

Sample size (N) under the study after excluding the cases was 173 (time bound study) within the study period, out of which 89 cases underwent laparoscopic repair and 84 cases underwent open repair out of which 9 cases were converted from laparoscopic to open repair.

- Institutional Ethical Committee approval to conduct the study was obtained prior to the commencing enrollment of patients. Written and informed consent was obtained from all the patients who participated in the study.
- Data on these patients were collected with use of a standard proforma on which were recorded age, sex, previous operation, preoperative evaluation, hernia size and location, previous hernia repairs, operating time, intraoperative and postoperative complications, postoperative hospital stay, date of last follow-up evaluation, and whether there had been a hernia recurrence.
- Choice of laparoscopic and open hernia repair for incisional hernia is left to choice of patient and the concerned attending consultant.
- Post operative pain, hospital stay, complications and followup were measured statistically according to the final type of repair done for the incisional hernia i.e; 80 laparoscopic repair and 93 open repair as 9 cases were converted from laparoscopy to open repair.
- Post operative pain is recorded at POD-1 and POD-3 using Verbal Numerical Rating Scale (VNRS) from 0 to 10 with 0 being no pain and 10 being maximum (worst pain ever in their life).
- Patients were followed up for minimum period of 6 months post operatively.
- Statistical analysis was done using IBM SPSS Statistics version 21.
- P-value were calculated using Independent sample t-test (parametric variables) and Mann Whitney's test (non-parametric variables).

Open mesh technique :

After taking patients to operative theater and under general anesthesia, endotracheal intubation was done and operation was started. Foleys catheter was put for patient with lower abdominal ventral hernia repair and nasogastric tube for

upper abdominal hernia repair with perioperative single dose of prophylactic antibiotic.

Then after proper cleaning, painting and draping of abdomen the skin incision made according to site and size of defect, subcutaneous flap raised up to 3 to 5 cm around the defect, the hernial sac found, contents reduced back then posterior rectus sheath and muscle dissected and between rectus muscle and peritoneum in lower abdomen .posterior rectus and peritoneum closed primarily with 2:0 absorbable suture, then polypropylene mesh of suitable size with minimum of 3 cm overlap beyond the margin of defect is placed over posterior rectus sheath / peritoneum and rectus muscle or above the repaired defect depending on the type of mesh repair (Figure 4).

Mesh is then fixed in four corners with 2:0 propylene sutures and taken out through abdominal muscle on the anterior rectus sheath, anterior rectus sheath closed over the mesh with a loop of polypropylene or nylon without tension, then skin closed over the drain/drains depending upon size and extension of the wound .



Figure 4 : Intra operative image showing preperitoneal mesh fixation

Surgical technique of laparoscopic hernia repair -

Pneumoperitoneum was established with use of a Veress needle inserted in either the left or right subcostal space. A direct view trocar was inserted laterally in a window between the iliac crest and costal margin. A 30- degree or 45-degree 5- or 10-mm laparoscope was used. Most hernias could be repaired with 1, 10- mm and 2, 5- mm ports placed laterally in the upper and lower quadrant, respectively. Adhesiolysis was performed, and the margins of the defect were clearly delineated (Figure 5).

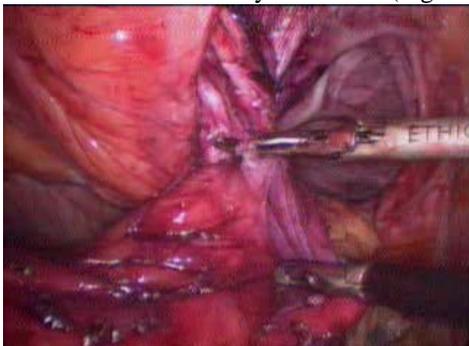


Figure 5: Intra operative image showing laparoscopic adhesiolysis and reduction of hernial sac

The hernia sac was not opened or dissected free. In general, the hernial sac is left in situ (Figure 6). After completion of adhesiolysis, the pneumoperitoneum is released, the maximal longitudinal and horizontal hernia diameter is measured and marked on the skin. An appropriate sized mesh is tailored in order to overlap the hernia margins by at least 5 cm on each side. In addition, the mesh should overlap the full length of the incision of the primary operation.

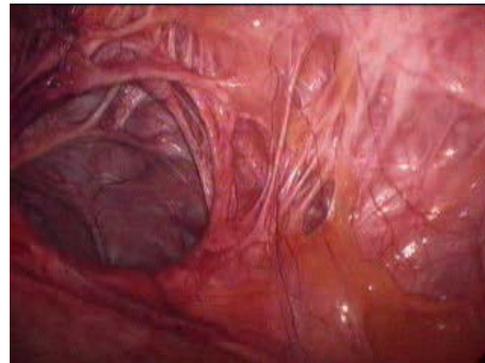


Figure 6: Intra operative image showing hernial defect after reducing the sac

There are 2 types of laparoscopic mesh used for laparoscopic repair in our institute, LOTUS (DUAL mesh) and PHYSIO (Flexible Composite mesh) mesh. Non absorbable monofilament sutures are present at corners along the mesh for LOTUS mesh (Figure 7).

The mesh is rolled up and inserted into the abdomen through a 12mm trocar. Then the mesh is rolled up and introduced into the abdominal cavity. After the mesh is positioned correctly in the abdominal cavity, the suture ties are pulled through the abdominal wall with a suture passer (epidural needle) and the threads are knotted smoothly with the knots buried in the subcutaneous tissue after reduction of the intraabdominal pressure to 8mmHg for LOTUS mesh.

We use absorbable tackers that are applied every 1 to 2 cm all around the hernial orifice and along borders of the mesh. Hemostasis is secured and ports are removed. Port closure done and tight pressure bandage applied to prevent post op seroma formation as the hernia sac is left in situ.



Figure 7: Intra operative image showing insitu LOTUS (dual) mesh

III. OBSERVATIONS & RESULTS

173 patients underwent incisional hernia repair within the study period of 18 months, out of which 89 cases underwent laparoscopic repair and 84 cases underwent open repair of incisional hernia.

9 out of 89 laparoscopic cases were converted to open procedure, out of which 2 cases were diagnosed to have incisional hernia defect after a diagnostic laparoscopy for chronic pain abdomen with normal imaging and an anatomical repair was done for both of the cases, rest of the 7 cases were converted due to dense adhesions.

Post operative pain, hospital stay, complications and followup were measured statistically according to the final type of repair done for the incisional hernia i.e; 80 laparoscopic repair and 93 open repair as 9 cases were converted from laparoscopy to open repair.

Mean age of patients in our study was 50.26 SD + 12.32 years, the youngest being 24 years and oldest being 80 years (Table 2). Out of 173 (N) patients in our study there were 40 (23.12%) males and 133 (76.88%) females showing a Male to female ratio of incisional hernia of 1 : 3.3 in our study.

Table 2 : Age distribution in the study population

	Range of Age (years)	Mean Age (years)	S.D
Laparoscopic	27-80	50.25	11.642
Open	24-76	50.27	13.076
Total	24-80	50.26	12.323

Previous surgeries which the patients underwent are shown in the (Table 3) as above in which laparotomy cases were separated as clean and infected cases. Peptic ulcer surgery (Gastrojejunostomy + Vagotomy), Retroperitoneal / Non bowel tumor (lymph nodal mass) excision or biopsy, cystogastrostomy and elective bowel resection were considered as clean cases and emergency surgeries with perforation peritonitis or bowel gangrene and elective surgeries with post op wound infection were considered as infected cases. Other cases mentioned in the pie chart were CABG(1) , open nephrolithotomy(1), open prostatectomy(1), stoma (ileostomy/colostomy) closure site(2) and lumbar sympathectomy(1),drain site hernia(2). Two incisional hernia cases presented post trauma after bull gore injury.

Fifteen patients out of 173 presented with recurrent incisional hernia which was operated at outside hospital previously.

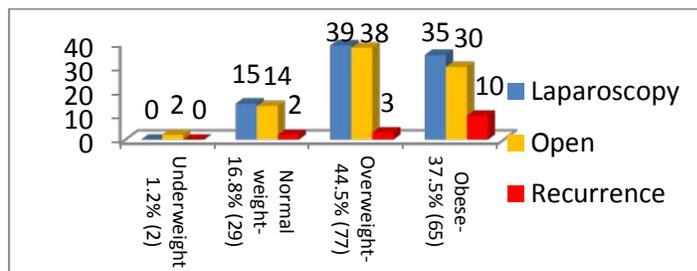
114 (65.9%) patients had presented with swelling over the abdominal wall alone and 32 (18.5%) patients presented with chronic abdominal pain alone and 27 (15.6%) patients presented with both swelling and abdominal pain.

BMI (Body Mass Index) in relation to incisional hernia incidence and recurrence are shown in bar graph below (Graph 1). There are 15 patients who presented with recurrent incisional hernia out of which 13 were above normal of which 3 are overweight and 10 patients are obese.

Table 3 : Prior abdominal surgeries in the study population

Previous Surgeries	Number
Laparotomy (Clean)	26 (14.3%)
Laparotomy (Infected)	32 (17.6%)
Cholecystectomy	7 (3.8%)
Appendicectomy	4 (2.2%)
Splenectomy	1 (0.6%)
Totalabdominal Hysterectomy	44 (24.2%)
Cesarean Section	40 (21.9%)
Tubectomy	15 (8.2%)
Post-Traumatic Hernia	2 (1.1%)
Port Site Hernia	3 (1.6%)
Others	8 (4.4%)
Total (N)	173

Graph 1: BMI distribution in the study population



According to EHS (European Hernia Society) Classification depending on the site of hernial defect, hernias are divided into midline and lateral hernias. 130 (75.14%) midline hernias were further divided into 5 groups depending on site of defect and 43 (24.86%) lateral hernias which were subdivided into 4 groups which were shown in the table given below (Table 4). There were no cases of lumbar site hernia seen in our study.

Table 4 : Classification of incisional hernia according to EHS classification

EHS Classification	Laparo scopy	Open	Total (173)	%of Incisional Hernia
MIDLINE HERNIAS (M)				
M-1 (sub-xiphoidal)	2	3	5	2.89%
M-2 (epigastric)	4	7	11	6.36%
M-3 (umbilical)	22	16	38	21.96%
M-4 (infra-umbilical)	30	27	57	32.95%
M-5 (suprapubic)	10	11	21	12.14%
LATERAL HERNIAS (L)				
L-1 (sub-coastal)	5	3	8	4.6%
L-2 (flank)	1	2	3	1.7%
L-3 (iliac)	15	15	30	17.4%
L-4 (lumbar)	0	0	0	NA

Depending on the width of the hernia defect it is again classified into 3 groups as shown in table below according to EHS Classification. For small hernial defect of < 4 cm, 45 underwent laparoscopic repair and 48 underwent open repair and for large defects >10cm only 5 underwent laparoscopic repair out of which 3 were converted and 7 underwent open repair (Table 5).

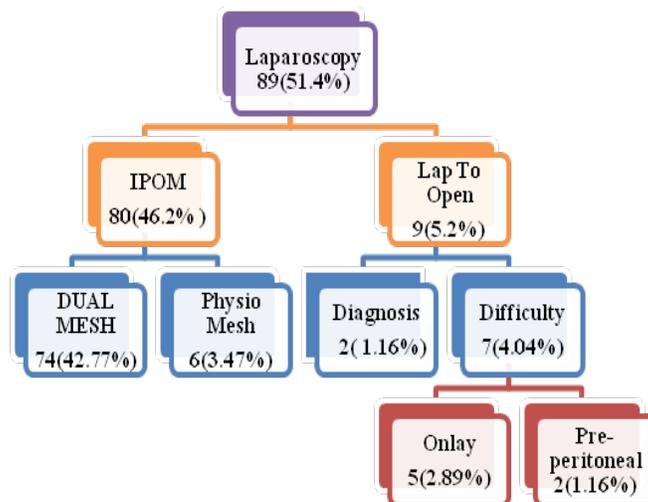
Table 5 : Hernial defect size in the study population

	Laparoscopy	Open	Total (173)
W-1 (<4cm)	45	48	93 (53.76%)
W-2 (>=4cm-<10cm)	39	29	68 (39.30%)
W-3 (>=10cm)	5	7	12 (6.94%)

Imaging modalities like Ultrasound and CT – Abdomen were done only in 47 (27.2%) patients and no pre operative imaging was done in 126 (72.8%) patients. Two cases were diagnosed after a diagnostic laparoscopy for chronic abdominal pain after undergoing imaging which was normal.

Eighty nine (51.4%) patients underwent laparoscopic repair out of which 9 cases were converted into open procedures in which 2 cases were diagnosed as incisional hernia on table and converted to open procedure in view of very small defect (<3 cm) where anatomical repair was done. Rest, 7 cases were converted due to dense adhesions to abdominal wall and difficulty in clearing adhesions laparoscopically (Flow chart 1).

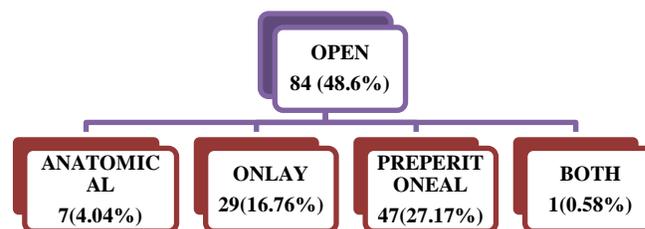
Flowchart 1 : Laparoscopic management of incisional hernia



Eighty four (48.6%) patients underwent direct open hernia repair which were again divided into anatomical, onlay and preperitoneal repair (Flowchart 2).

The choice of open and laparoscopy repair was left to the patient and consultant choice and no intervention was done in selecting the type of repair for the study.

Flowchart 2 : Open procedure for incisional hernia



Multiple hernia defects (Swiss-cheese pattern) are seen in 29.21% (26 out of 89 cases) of cases operated by laparoscopic method while 11.9% (10 out of 84 cases) of them are detected in case of open incisional hernia repair.

The mean of size of hernial defect in laparoscopic repair is about 15.39 cm² with S.D of 11.942 while it is about 19.44 cm² with S.D of 29.092.

The mean duration of surgery for laparoscopic repair is 125.67 minutes with S.D of 49.274 and for open repair it is about 118.45 minutes with S.D of 43.45.

There is no significance in P-value calculated for duration of surgery and defect size.(Independent t-test) (Table 6).

Table 6 : Duration of surgery and defect size in the study population

	Laparoscopy Mean(Range)	Open Mean(Range)	P-value
Duration of surgery(min)	125.67 (60-300)	118.45 (60-330)	0.936
Defect size (cm ²)	15.39 (4-60)	19.44 (2-160)	0.998

Post operative pain, hospital stay, complications and follow up were measured statistically according to the final type of repair done for the incisional hernia i.e; 80 laparoscopic repair and 93 open repair as 9 cases were converted from laparoscopy to open repair.

Post operative pain is calculated at POD-1 and POD-3 using pain scale grading from 0 to 10 for both the groups. Mean pain value at POD-1 for laparoscopic repair is 3.72 +/- 0.953 and open repair is 4.4 +/- 0.907 while mean pain value at POD-3 for laparoscopic repair is 1.38 +/- 1.061 and open repair is 2.4 +/- 0.808.

Post op hospital stay for the patients in both groups is compared by calculating mean duration of stay which is about 5.28 days (S.D +/- 2.509) in laparoscopic group and 8.57 days (S.D +/- 4.163) for open repair group.

P-values are calculated using Mann-Whitney Test and independent sample T – test which showed significant value of < 0.001 (Table 7).

On gross outlook post op complication for both laparoscopic and open repair are high and alarming (Table 8,9). Post op complications of both procedures are compared and laparoscopic repair showed complications in 31.25% (25 out of 80) of cases.

However most of the complications are minor and did not require any intervention and was managed conservatively.

Only 13.75% (11 out of 80) required hospitalization for management of complications in laparoscopic repair. Open repair on total showed complication rate of 36.56% (34 out of 93 cases) and among which some of them are managed conservatively without hospitalization but in spite of which 27.96% (26 out of 93) of complications required hospitalization. Wound related complications are only 4 (5%) in case of laparoscopic repair while it is about 19 (20.4%) in case of open repair.

Recurrence rate for incisional hernia operated in our hospital were 3 out of 80 (3.75%) in case of laparoscopy and 4 out of 93 (4.3%) in case of open repair.

Out of the 4 open recurrence cases 1 was converted from laparoscopy to open due to dense adhesion and an open repair was done for it.

Table 7 : Pain scale and Post operative hospital stay in the study population

	Laparoscopy (Mean/Range)	Open (Mean/Range)	P-value
Pain scale			
POD-1	3.7 (2-7)	4.4 (3-7)	< 0.001
POD-3	1.4 (0-4)	2.4 (1-4)	< 0.001
Post op hospital stay			
No of days	5.28 (1-13)	8.57 (3-30)	< 0.001

Table 8 : Complications in the study population

Complications		Laparoscopic Repair (89 – 9 = 80)	Open repair (84+9=93)
Local complications			
1	Wound infection (SSI)	4	12
2	Flap necrosis	0	7
3	Seroma	6	5
4	Hematoma	2	0
5	Suture granuloma	1	0
6	Mesh infection	0	1
7	Mesh migration	1	0
8	Prolonged ileus	4	2
9	Bowel injury	0	1
Systemic complications			
1	Pulmonary Complications	3	0
2	Cardiac Complications	0	0
3	Genitourinary Complications	0	0
4	DVT	1	2
Recurrence		3 (3.75%)	4 (4.3%)
Total Complications		25 (31.25%)	34 (36.56%)

Table 9 : Complications in the study population

	Laparoscopic repair	Open repair
Wound related complications	5% (4)	20.4% (19)
Interventional Complications	13.75% (11)	27.96% (26)
Total Complications	32.5% (26)	35.5% (33)

Patients are followed up for minimum of 6 months and maximum of upto 23 months by follow up visits. 76.25% of patients came for follow up in case of laparoscopic repair with mean follow up time of about 5.22 months. 75.27% of patients came for follow up in case of open repair with mean follow up time of about 7.46 months (Table 10).

Table 10 : Follow up in the study population

	Laparoscopy	Open
Total patients	80	93
No follow-up	19	23
No. of follow-up patients	61 (76.25%)	70 (75.27%)
Mean time of follow-up (months)	5.22	7.46
Range (months)	6-23	6-23

IV. DISCUSSION

Obesity is a perhaps the most important factor, in the causation and recurrence of incisional hernias in this study. Incidence of incisional hernia is more as patient is obese showing 82.1% of cases of incisional hernia with above normal BMI. 87% of recurrent incisional hernias presented to us are above normal weight and out of which 67% are obese. Increased recurrence rates are also seen in the obese after repair of incisional hernias. However, obesity still poses an increase in both wound complications and recurrences rates, even using the laparoscopic approach. It is therefore desirable for patients to lose weight preoperatively if possible.

Characteristics of incisional hernia observed in our study are the presenting symptoms and site of hernial defect. Most of the patients of incisional hernia defect presented with swelling

alone and no imaging is usually required as it is a clinical diagnosis.

Pre-operative imaging was done in 27.2% of the cases in our study, while some cases even though it was clinically evident imaging was done to rule out other causes of chronic pain abdomen other than incisional hernia.

Rodriguez et al. [15] found an incidence of 23% for abdominal wall hernias with CT scanning after open abdominal aortic aneurysm repair while only 8% of the patients had clinical evidence of an incisional hernia. Thus imaging may help in high risk patients of recurrence for its early detection and less perioperative comorbidity as they requires surgery eventually after a period of time. CT abdomen is a sensitive investigation compared to USG, while diagnostic laparoscopy is considered as a superior investigation from that of any imaging.

Most of the incisional hernias are midline hernias which are about 75.14% while remaining, 24.86% are lateral hernias. Very few of the incisional hernia studies were classified according to the site of hernial defect, one such study was Muysoms et al [9] where midline hernias account to 76.9% while lateral hernias account to 23.1% which is similar to our study findings.

In our study we found that although laparoscopic incisional hernia (Mean duration of surgery-125.7min) repair took longer time to perform than open repair (118.4min), while some studies by Asencio et al [19] and Barbaros et al [17] how a similar longer duration of laparoscopic surgery, some other studies like Misra et al [18] and Olmi et al [19] go against the study.

Range of the time for surgeries is around the same for both the cases in our study which is, minimum around 60 minutes and maximum around 300 minutes. Longer duration of laparoscopic surgeries in our study can be attributed to the learning curve of surgeons in our hospital and is due to difficulty in case due to dense adhesions and reducing the contents, all through laparoscopic approach. While some complex cases of open hernia repair were also time consuming in order to do repair by a pre-peritoneal approach. Most of the open cases were planned for pre-peritoneal repair unless otherwise complicated or if there was difficulty in creating the plane.

Conversion rate of laparoscopic repair into open repair in our study is about 5.2% (9 out of 89 cases) out of which 2 cases were diagnostic laparoscopies followed by open repair to prevent the cost of intraperitoneal dual mesh charge as consent was not taken for placement of a costly intraperitoneal dual mesh. Rest 7 cases were converted to open in view of dense adhesions and difficulty in reducing the contents laparoscopically in fear of bowel injury. The lack of expertise by the concerned operating surgeon in laparoscopic repair can also be attributed to the higher conversion rate in our study. McGreevy et al [20] study showed similar conversion rate of 4.6% (3 out of 65 cases) of the cases.

Our patients in the laparoscopic repair group had a shorter duration of hospitalization and probably faster recovery time than those in the open repair group. The mean of post op hospital stay in our study is about 5.3 days in case of laparoscopic repair and 8.6 days in case of open repair which was relatively very high when compared to other comparative studies, Pring et al [21] which is around 1 -3 days except in a study conducted by Olmi et

al which is about 2.7 days for laparoscopic repair and 9.9 days for open repair [19].

Longer duration of hospital stay when compared to other studies is mainly due to discharge of patient only after complete attainment of regular activity and also in some cases, because of insurance reasons.

Post-operative pain in our study is calculated on POD -1 and POD-3 using Verbal Numerical Rating Scale (VNRS) in our study which showed significant decrease ($P < 0.001$) in laparoscopic surgery (POD-1 -3.7; POD-3- 1.4) compared to open surgery (POD-1 - 4.4; POD-3 -2.4). Main reason for selection of POD-3 timing is to eliminate the pain caused by tackers used in laparoscopic repair which pierces the parietal peritoneum and causes more pain in the immediate post op in case of laparoscopic repair. Some studies like Asencio et al [16] have shown increased post op pain in case of laparoscopic repair compared to open repair, this might be attributed to the trans parietal suturing along with the tackers which was used to fix IPOM. But most of the studies which had taken VNRS to compare post op pain showed decrease in post op pain in laparoscopic repair compared to open repair but has not showed statistical significance as in Barbaros et al [17] and Misra et al [18] study.

In this study fewer wound complications occurred in patients who underwent laparoscopic operation than in those who had an open procedure.

There are about 5% wound related complications in laparoscopic group compared to 20.4% in case of open repair group which is around 4 times more in case of open repair. These findings are similar to study conducted by Misra et al [18] where only wound related complications are specifically separated which is about 6% in case of laparoscopic repair and 33% in open repair of incisional hernia. In a series by Olmi and colleagues [19], wound complications also were noted to be significantly lower in laparoscopic hernia repairs than in open repairs (1.1% versus 8.2%).

There is 1 case of mesh removal done in open hernia repair because of mesh infection which was repaired by component separation while there is 1 case of mesh migration seen in laparoscopic repair for which again IPOM was placed laparoscopically. The cause of mesh infection is due to wider tissue plane dissection and prolonged surgery while that for mesh migration might be due to improper coverage of the hernial defect using mesh. The site of the original incision had no influence on recurrence rate in the study by Hesselink et al [22].

More cases of prolonged ileus were observed in the laparoscopic repair group, 5% than in the open repair group, 2.2% in this study. This may have been because the condition was more evident in the quickly recovering patients in the laparoscopic group and was overlooked or under reported in patients in the open group, who had a more prolonged convalescence.

Hernia recurrence rates in our study were 3.75% in case of laparoscopic repair and 4.3% in case of open repair. However, we found that recurrence was associated with high BMI and wound complications. Recurrence rate in similar comparative studies are variable with 9.7% recurrence in case of laparoscopic repair and 7.9% recurrence in open repair. While there is no recurrence seen in some studies like Navarra et al [23].

High BMI with recurrence is seen in 100% of cases in laparoscopic group and in 75% of cases of open group. (laparoscopic - 2 obese, 1 overweight and open recurrences - 2 obese, 1 overweight).

Perioperative surgical site occurrence (SSO) defined as infection, seroma, wound ischemia, and dehiscence, increases the risk of recurrent hernia by at least 3-fold according to Sanchez et al [24]. Perioperative SOO causing recurrence in our study is 1.4 times than normal recurrences due to other factors.

Drawbacks of the study are, it is an observational study alone and no randomization was done regarding selection of comparable cases. Since all the surgeries have been performed by different surgeons of different caliber standardization could not be done. Even the type of repair in open type is not taken into consideration while analyzing post op complications and recurrence of hernia.

Overall cost effectiveness and mesh selection in both the procedures was not analyzed in our study, which is main limiting factor for choosing laparoscopic over open repair of incisional hernia.

To date, only a very few randomized trials exist [25,26] and comparative study cohorts if randomized are of very small study population mostly ($N < 100$). Larger population studies need to be done with better randomization of population for better analysis and reliable results from the study.

V. CONCLUSIONS

- Laparoscopic incisional hernia repair should be the first line of surgery for incisional hernia repair as there is less chance of post op wound related complications and morbidity as such if the patient is fit for general anesthesia.
- Obesity is perhaps the most important factor, in the causation and recurrence of incisional hernias and pre-operative weight reduction is very important pre requisite for success of laparoscopic hernia especially.
- Pre-operative imaging helps in early diagnosis of small incisional hernia in obese patients and also in identification of contents and their condition within the hernial sac. Role of imaging in incisional hernia repair need to be further evaluated in future studies.
- Laparoscopic repair is better for detection of multiple defects of incisional hernia compared to open repair.
- Post op pain , length of hospital stay and post-operative readmission are less in laparoscopic surgery compared to open repair.

VI. REFERENCES

1. George CD, Ellis H. The results of incisional hernia repair: a twelve year review. *AnnRCollSurgEngl* 1986 Jul;68(4):185-7.

2. Read RC, Yoder G. Recent trends in management of incisional herniation. *Arch Surg* 1989;124:485–8.
3. Condon RE. Ventral abdominal hernia. In: Baker RJ, Fischer JE, editors. *Mastery of surgery*. 4th edition. Philadelphia: Lippincott Williams & Wilkins; 2001.
4. Ceydeli A, Rucinski J, Wise L. Finding the best abdominal closure: an evidence-based review of the literature. *Curr Surg* 2005; 62(2):220-225.
5. Millikan KW. Incisional hernia repair. *Surg Clin North Am* 2003;83:1223–34.
6. Playforth MJ, Sauven PD, Evans M, et al. The prediction of incisional hernia by radio-opaque markers. *Ann R Coll Surg Engl* 1986;68(2):82–4.
7. Poole GV Jr. Mechanical factors in abdominal wound closure: the prevention of fascial dehiscence. *Surgery* 1985;97(6):631–40.
8. Bucknall TE, Cox PJ, Ellis H. Burst abdomen and incisional hernia: a prospective study of 1129 major laparotomies. *Br Med J (Clin Res Ed)* 1982;284(6364):519–20.
9. F. E. Muysoms , M. Miserez , F. Berrevoet , G. Campanelli , G. G. Champault , E. Chelala ; Classification of primary and incisional abdominal wall hernias; *Hernia* (2009) 13:407–414
10. Flament JB, Avisse C, Palot JP, Pluot M, Burde A, Rives J. Trophic ulcers in giant incisional hernias pathogenesis and treatment. *Hernia* 1997; 1(2):71-76.
11. Courtney CA, Lee AC, Wilson C, O’Dwyer PJ. Ventral hernia repair: a study of current practice. *Hernia* 2003; 7(1):44-46.
12. Asencio, J. Aguilo, S. Peiro, J. Carbo, R. Ferri, F. Caro and M. Ahmad. (2009). Open randomized clinical trial of laparoscopic versus open incisional hernia repair. *Surg Endosc*, Vol. 23, No. 7, pp.1441-1448.
13. Itani KMF, Neumayer L, Reda D, et al. Repair of ventral incisional hernia: the design of a randomized trial to compare open and laparoscopic surgical techniques. *Am J Surg* 2004;188:22S–9S.
14. Franklin ME Jr, Gonzalez JJ, Glass JL, et al. Laparoscopic ventral and incisional hernia repair: an 11-year experience. *Hernia* 2004;8:23–7.
15. Rodriguez HE, Matsumura JS, Morasch MD, Greenberg RK, Pearce WH (2004) Abdominal wall hernias after open abdominal aortic aneurysm repair: prospective radiographic detection and clinical implications. *Vasc Endovasc Surg* 38: 237-240.
16. F. Asencio, J. Aguilo, S. Peiro, J. Carbo, R. Ferri, F. Caro and M. Ahmad. (2009). Open randomized clinical trial of laparoscopic versus open incisional hernia repair. *Surg Endosc*, Vol. 23, No. 7, pp.1441-1448.
17. Barbaros U, Asoglu O, Seven R, Erbil Y, Dincceg A, Deveci U et al. The comparison of laparoscopic and open ventral hernia repairs: a prospective randomized study. *Hernia* 2007; 11: 51–56.
18. Misra MC, Bansal VK, Kulkarni MP, Pawar DK. Comparison of laparoscopic and open repair of incisional and primary ventral hernia: results of a prospective randomized study. *Surg Endosc* 2006; 20: 1839–1845.
19. Olmi S, Scaini A, Cesana GC, et al. Laparoscopic versus open incisional hernia repair. *Surg Endosc* 2007;21:555–9.
20. McGreevy JM, Goodney PP, Birkmeyer CM, Finlayson SR, Laycock WS, Birkmeyer JD. A prospective study comparing the complication rates between laparoscopic and open ventral hernia repairs. *Surg Endosc*. 2003;17:1778-80.
21. Pring CM, Tran V, O’Rourke N, Martin IJ. Laparoscopic versus open ventral hernia repair: a randomized controlled trial. *ANZ J Surg* 2008; 78: 903–906.
22. Hesselink VJ, Luijendijk RW, de Wilt JHW, Heide R, Jeekel J. An evaluation of risk factors in incisional hernia recurrence. *Surg Gynecol Obstet* 1993;176:228-34.
23. Navarra G, Musolino C, De Marco ML, Bartolotta M, Barbera A, Centorrino T. Retromuscular sutured

- incisional hernia repair: a randomized controlled trial to compare open and laparoscopic approach. Surg Laparosc Endosc Percutan Tech 2007; 17: 86–90.
24. Sanchez VM, Abi-Haidar YE, Itani KM. Mesh infection in ventral incisional hernia repair: incidence, contributing factors, and treatment. Surg Infect (Larchmt) 2011;12(3):205–10
25. LeBlanc K. A., Booth W. V. Laparoscopic repair of incisional abdominal hernias using expanded polytetrafluoroethylene : preliminary findings. Surg Laparosc Endosc, 1993, 3 : 39-41.
26. V. Schumpelick, J. Conze and U. Klinge. (1996). [Preperitoneal mesh-plasty in incisional hernia repair. A comparative retrospective study of 272 operated

incisional hernias]. Chirurg, Vol. 67, No. 10, pp.1028-1035.

AUTHORS

First Author & Correspondence Author – Dr. Vijay Koduru, MS (General surgery), Senior Resident, Kasturba Medical College, Manipal University.
Email: koduruvijay7@gmail.com, mobile no: +91-9686323447.

Second Author – Prof. Annappa Kudva, MS (General surgery), Professor and Unit Head, Kasturba Medical College, Manipal University.
Email: annappakudva@yahoo.com

Third Author – Dr. Ravikiran Naalla, MS (General surgery), Junior Resident, Kasturba Medical College, Manipal University.
Email: ravi_2488@yahoo.co.in

Effects of Motivation Stress Factors on the Performance of Employees in Public Universities in Kenya

John Ng'ang'a Karihe¹, Professor G. S. Namusonge², Dr. Mike Iravo³

¹Doctor of philosophy in Human Resources Management of Jomo Kenyatta University of Agriculture and Technology

²Supervisor, Jomo Kenyatta University of Agriculture and Technology

³Supervisor, Jomo Kenyatta University of Agriculture and Technology

Abstract- The aim of this study was to assess the effects of staff motivation on the performance of employees at the public universities in Kenya. Specifically the study seeks to find out the effect of motivation stress factors on the performance of employees in public universities in Kenya. The study employed a cross-sectional evaluation survey approach. This used both qualitative and quantitative methods in the selection of the participants and collection of data. Cluster sampling was employed to select 384 respondents. Data collection instruments included interviews, questionnaires and document reviews. The collected data was captured in MS Excel and analyzed using SPSS version 24 (Statistical Package for Social Scientists). Linear regression analysis and Pearson's correlation coefficient were run to determine relationship between stress factors and workers performance. The analyzed data was presented in suitable graphs, charts and tables. By correlating the determinants of stress with performance, the study found out that the determinants of stress include movement, motivation, workers relationships, management and working facilities. The study found a significant relationship ($F(3,342) = 57.717, p < 0.05$) between Motivation and Management and employee performance. The nature of the relationship was found to be positive in the sense that unit increase in Worker's relationship, Worker's movement, Workplace facilities and Management leads to an increase in Employee performance as demonstrated by the equation: Employee performance = $2.286 + .096 \text{ Management} + .277 \text{ Motivation}$

Index Terms- motivation, stress factors, employee performance

I. INTRODUCTION

Workers stress is defined by Manjula (2010) as the harmful physical and emotional responses that can happen when there is a conflict between job demands on the worker and the amount of control a worker has over meeting these demands. In general, the combination of high demands in a job and a low amount of control over the situation can lead to stress.

Rosania et al.' (2009) however defined workers' stress as the experience by a worker of unpleasant emotions, such as tension, frustration, anxiety, anger, and depression, resulting from aspects of work. In recent years, steadily increasing costs and consequences of workers stress has received growing concern. To reduce the negative effects stress has on workers, more attention needs to be placed on this growing epidemic (Nilufar, Zaini, David & Sayeed, 2009).

High level of stress at work is a major threatening factor to both physical and psychological health of individuals (Dar, Akmal, Naseem & Khan, 2011) and affects their cognitive processes involving memory, recall of knowledge and attention (Addae, Parbooteah & Velinor, 2008). Stress management therefore has dominated many forums both locally and internationally. In the public academician congress in the university of Khang Valley (Nilufar et al., 2009), job stress and its effects was discussed. Working staff in the universities worldwide have found themselves in dissatisfactions that have greatly manifested themselves in different ways.

Workers in the Universities have often found themselves in dissatisfactions that have manifested them greatly in the recent past. In November 2011, a major strike was held nationwide in Kenya by all the public universities workers. This led to the closure of several universities. This strike among other things affected learning, examinations and graduation programmes. Concurrently there was a go slow in Brazil in October and November by dissatisfied university lecturers. It is with this background that the researcher seeks to carry out a study in selected universities in Kenya to establish the effects of occupational stress on employees' performance and provide practical coping strategies that can be employed to reduce or completely alleviate stress in public universities.

In achieving the Universities objectives, the workers play an important role. The performance of the workers determines to a large extent, the quality of the student experience of University education and has a significant impact on student learning and thereby on the contributions that such institutions can make to society (Ramzan, 2012). Report by the National Institute for Occupational safety indicates that stress in organisations caused by poor management, inadequate facilities, lack of motivation, poor relationships and constant movement of workers due to job allocation or shifts, if not addressed leads to poor performance of the employees. When people are under stress, they are often less concerned, less vigilant and less efficient (Dar et al, 2011).

According to Waswa and Swaleh (2012) minimal attention has been given towards ensuring workers in public universities have been provided with the necessary resources, motivation, effective job allocation measures and management to avert continuous strikes that have lowered the standards of education in the country. Additionally Owino et al (2013) argues that lack of resources, motivation, poor leadership and negative relationships leads to stressed employees and poor performance. Zhimin and Ramani (2012) advises that stress factors should be met to enhance conflict resolution within Kenya's public universities. This study therefore seeks to assess the effects of

motivational stress factors on employee performance of public universities and their contribution to the performance of workers. The study aimed at determining the effect of motivation stress factors on the performance of employees in public universities in Kenya. This study shall shed light on the causes of increased rate of stress at workplaces in the public universities that has not yet been addressed. The findings of this study may be used by policy makers in the universities, both the management and workers' unions to strengthen stress relieving activities, motivation and create programmes that will be of help in stress management. With the findings of this study and recommendations implemented, the universities will have less absenteeism due to sickness, with the rate of sickness reduced; medical expenses will also be reduced hence economic growth and a healthier lifestyle. Workers will be present at work and will have high productivity. With other researches done in this field, this study will increase the pool of academic knowledge in the area. Finally, the findings from this study may also generate knowledge that can be useful to other scholars for further research.

II. LITERATURE REVIEW

2.1 Theoretical framework

This section discusses the theories explaining workers stress factors and their effects on workers performance. The theories underpinning this study therefore include the relational theory, homeostasis theory, Welford's performance and demand theory and the Hertzberg's two factor theory.

2.1.1 Relational theory

In his theory, Lazarus regards stress as a relational concept, that is, stress is not defined as a specific kind of external stimulation or a specific pattern of physiological, behavioural, or a subjective reactions. Instead, stress is reviewed as a relationship between individuals and their environment. Psychological stress involves relationship with the environment that an individual appraises as significant for his or her well-being and in which the demands tax or exceed available coping resources. These definitions points to two processes as central mediators within the person-environment transaction: cognitive appraisal and coping.

This concept is based on the idea that emotional processes (including stress) are dependent on actual expectancies that persons manifest with regard to the significance and outcome of a specific encounter. This concept is necessary to explain individual differences in quality, intensity, and duration of an elicited emotion in environments that are objectively equal for different individuals. The most important factors on the personal side are motivational dispositions, goals, values and generalized expectancies. Relevant situational parameters are predictability, controllability, and imminence of a potentially stressful event.

2.1.2 Homeostasis theory

According to Mojinyinola (2008), the body possesses internal mechanism to maintain a stable bodily functioning or equilibrium. As the environment presents the organism with various challenges, the body must respond to each new situation and by adjusting various physiological systems to compensate for the resources being taxed. A classic example of this type of compensation involves fluid regulation. When an organism ingests a large amount of water, the kidney releases more waste

fluid into the bladder for eventual disposal in an effort to maintain bodily equilibrium. Many of the feedback mechanisms that regulate blood pressure presented in the body share similar characteristics with bodily systems that maintain homeostasis. According to Mojinyinola (2008), failure of the body to respond to environmental challenges by maintaining bodily homeostasis results in damage to target organs and eventually death. The concept of homeostasis introduced therefore proves to be very valuable in explaining how acute physiological stress responses to threats of survival would lead toward chronic stress responses.

2.1.3 Hertzberg's two factor theory

Hertzberg's two factor theory has been used to explain occupational stress. He carried out his now famous survey in 200 accountants and engineers from which he derived his initial framework for his theory (Steers & Porter, 1987). The theory argues that job satisfaction depends on the motivator factors which include variables such as achievement, recognition, the work itself, responsibility advancement and growth. Conversely dissatisfying experiences called hygiene factors resulted largely from extrinsic, no job related factors such as company policies, salary and supervisory style. Cox (1980) in his studies on stress posits that lack of job satisfaction results to stress and improving the hygiene factors by redesigning and enriching jobs will promote satisfaction. This will in return reduce stress and improve performance. Hertzberg's work is credited for its stimulating thought of introducing motivation at the workplace and therefore giving people a better understanding of job related stress. Critics of this theory argue that it does not give sufficient attention to individual characteristics which are very important in understanding human behaviour (Bloona 2007).

2.1.5 Stress Theory Model

A model is a systematic organization of knowledge on some topic. There are several models developed to provide an insight on stressors and their coping strategies. This study will however major on only two models to explain stressors and one model focusing on stressors and their coping strategies.

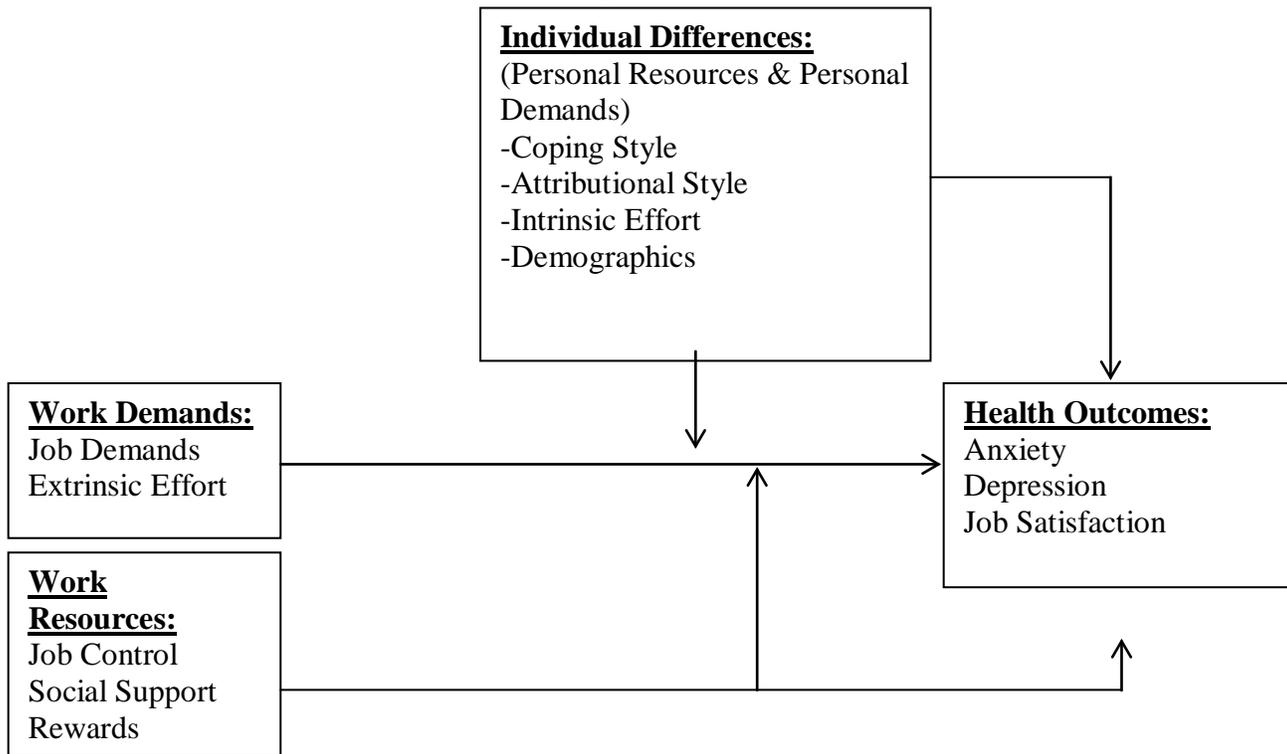
a) Demands, Resources, and Individual Effects model

In light with the literature on stress models, Mark and Smith (2008) suggested the DRIVE model that perhaps elucidates stressors effectively. In this model they acknowledge the important role played by psychosocial workplace stressors in the stress process, and tries to account for the role of important individual difference factors in the development of subjective experiences of stress, and in influencing the possible health-related outcomes that result from subjective stressful perceptions. This framework aims to represent key aspects of the stress process, without getting bogged down in the minutiae of more complex theories and mental processes.

They developed and tested the model shown below which simultaneously compared a number of job characteristics and individual difference variables in the prediction of anxiety, depression, and job satisfaction, in a working population. Independent variables included: job demands, social support, decision authority, and skill discretion; extrinsic effort, intrinsic effort and rewards; 40 coping behaviours which included the categories of problem focused coping, seeking advice, self blame, wishful thinking, and escape/avoidance; attributional/explanatory styles; and age, gender, and

demographic variables. This framework was called the Demands, Resources, and Individual Effects model (DRIVE). Source: Mark and Smith (2008)

Figure 2.1 The DRIVE model



In the model, workplace and individual characteristics are conceived of in terms of work demands and resources, and individual demands and resources. Other work demands and resources could include workload, bullying, job security, management style, feedback etc, and other personal demands and resources could include self efficacy, locus of control, personality, home environment, experience, work/life balance, role conflict, etc.

The model proposes that work demands, individual differences, and work resources are all proposed to have main effect relationships on anxiety, depression, and job satisfaction (other outcomes could include organizational commitment, musculoskeletal disorders, gastro-intestinal disorders, heart disease, absence). It is also proposed that work resources and individual differences may moderate the relationship between work demands and health outcomes. The individual difference variables of positive coping (problem focused coping) and attributional styles can be seen as personal resources, and intrinsic effort, negative coping (self-blame) and attributions as “personal demands”, as maladaptive behaviours are effectively self-induced demands. This model makes no predictions about the “importance” of the different variables in predicting outcomes, and gives each type of variable (work and individual demands and resources) a theoretical equivalency.

b) The cognitive theory of psychological Stress and coping

Lazarus and Folkman’s theory of psychological stress and coping (1980) is perhaps the most theoretically influential

transactional theory. Sometimes known as the Cognitive-Relational approach, the individual and their environment are seen as coexisting in a dynamic relationship, where stress is the psychological and emotional state that is internally represented as part of a stressful transaction (Folkman, Lazarus, Gruen&DeLongis, 1986).

The two key concepts in this process are appraisal and coping (Cox et al., 2000).Folkman et al (1986) describe primary appraisal as the first stage of the appraisal process, where encounters are subjectively evaluated to see what is at stake in terms of potential risk (Perrewe&Zellars, 1999) and these assessments allow for the influence of individual differences, because the nature of what is considered stressful is individual-specific (Park &Folkman, 1997).

In later work, Park and Folkman (1997) write that the attribution of meaning that individuals give to events, can be framed by existing beliefs based on their global meaning. These are enduring beliefs and valued goals, based on fundamental assumptions, theories of reality (e.g. religion), self-worth, life experience etc. Park and Folkman (1997) propose that the making of situational meaning is what occurs when an individual’s global beliefs and goals interact with the specifics of a particular person-environment transaction which are defined by the processes of appraisal and coping.

If a situation is evaluated as potentially stressful, then secondary appraisal occurs, which is where the individual evaluates if the potential harm can be altered, avoided or prevented (Park &Folkman, 1997), where to assign blame or

credit, and what future expectations are. Potential actions or ways of coping are assessed, informed by past coping experience, personality, personal resources (and presumably global meaning). Folkman and Lazarus (1980) described many types of coping behaviours, and suggested that they could be aggregated into two major categories of coping response: problem-focused coping (attempts to cope using more rational problem solving type approaches) or emotion-focused coping (emotional-oriented coping approaches) each of which are suitable in different kinds of situation.

While the problem focused/emotion focused distinction has been popular in research, many argue that it is important to split coping into more distinct categories (many based on Folkman and Lazarus' work) such as problem focused coping, seeking social support, blamed self, wishful thinking, and avoidance (Vitaliano, Russo, Carr, Maiuro & Becker, 1985) and action oriented coping, accommodation, positive thinking, seeking support, self-blame and defence (Falkum, Olf & Aasland, 1997). Once possible coping methods are assessed and selected, then the final stage of the model occurs, where coping is implemented. Coping has been characterized as (Folkman et al, 1986) "cognitive and behavioural efforts to manage (reduce, minimise, master, or tolerate) the internal and external demands of the person-environment transaction that is appraised as taxing or exceeding the person's resources". Robbins, Judge and Sanghi (2009), suggest that coping is the main method by which incongruence between global meaning and situational meaning is managed. A failure to cope successfully (from excessive demands or lack of resources) is likely to lead to stress and negative health and organizational outcomes (Chaudhry, 2012). Motivation involves the ability to make somebody want to do something especially something that involves hard work. Research has shown that having a say in what happens in the workplace helps employees to generate greater ownership over their work, to address or avoid stressful situations, and over all, to achieve higher levels of well-being (Noblet, 2003).

The challenge for the universities involved in the present study is to address the perception of salary inequity and ensure that employees feel they are fairly recognized and rewarded for their work. This research will adequately address the question of motivation to clearly establish whether workers in the selected universities are properly motivated and whether lack of motivation could have been the cause of demonstrations and strikes in public universities in the recent past. This study therefore hypothesises that:

2.2 Empirical Studies carried on causes and effects of Stress

The literature indicates that there is a relationship between age, gender, marital status, educational level, position, length of service and working experience with occupational stress (Landa et al. 2008; Lu, Siu & Cooper, 2005) but the results of a study that was conducted on urban police officers in the USA, showed that dynamic factors such as work environment and coping mechanisms, contributed more to explain variance of police stress than static factors such as race and gender (He, Zhao & Ren, 2005). In several studies income, heavy workload, lack of workspace, lack of resources (including equipment and material to do tasks), absence of proper company procedures, insufficient time to perform duties, meeting deadlines imposed by others,

have been introduced as stressors related to work environment (Botha & Pienaar, 2006). In other studies external accountability, responsibility, work relationships, insufficient consultation, communication, inadequate feedback on performance and organizational changes have been introduced as sources of occupational stress (Sveinsdottir, Biering & Alfons, 2006).

According to Beehr, (2005) work overloads and time constraints were significant contributors to work stress among community nurses. Workload stress can be defined as reluctance to come to work and a feeling of constant pressure (i.e. no effort is enough) accompanied by the general physiological, psychological, and behavioural stress symptoms (Larson, 2004). Al-Aameri (2003) has mentioned in his studies that one of the six causes of occupational stress is pressure originating from workload. Alexandros-Stamatios, et al. (2003) also argued that "factors intrinsic to the job" means workload, variety of tasks and rates of pay.

Grwywacz (2004) conducted a research on stress and education level among 1031 workers. He found out that less educated people suffer few stressful days but when they suffer stress it's more severe and had a large impact on their health. Combs (2004) on the other hand, conducted a research on marital status and stress among 300 workers and found that married couples reported more stress than their single counter parts.

Karatepe et al (2012) conducted a research on role stress, emotional exhaustion and turnover on frontline hotel employees in Cyprus. The results showed that the positive effect of role conflict and emotional exhaustion on turnover intentions was weaker among the frontline employees with longer tenure. Cavanaugh et al (2010) also conducted a research on role conflict and personality among managers. They found that individuals with type B personality managed conflict better and were better off at managing large organizations.

Philips Campbell and Morrison (2010) conducted a research on satisfaction, stress and spousal support among 242 married veterans. Both genders reported that income and time required for work was the greatest dissatisfaction. Males reported more spousal support on their careers. They proposed a study on the interactive effect among combination of stressors that are commonly found in the world of work. No differences were found between the genders on the effect of work related stress.

Sultana (2012) carried out a study on the nature and impact of teacher stress in the private schools of Gilgit-Baltistan in Pakistan. Analysis of the findings of the study resulted in categorizing them into three groups: personal stress, professional stress and financial stress. However, the impact of each one of the three groups of teacher stress (i.e. personal, professional and financial) was different for different teachers. It looked like some teachers felt more stressed because of a variety of personal and domestic factors, whereas other teachers felt more constrained because of financial issues. Furthermore, the data analysis also highlighted the sources of teacher stress, which could be easily identified as the "inside-school" and the "outside-school" sources of stress. The various findings related to each one of the two categories are revealing as they show the significance and degree of enormity of stress factors related to these groups.

Blomme, Rheede and Tromp (2010) conducted a research on work life programmes and firm productivity among 658 US organizations. It was fully established that organizations that had

extensive work life programmes enjoyed productivity benefits. They suggested further research that takes into accounts other organizational variables such as job satisfaction and organizational commitment.

Deaconu (2011) conducted a research on stress management and performance among 180 sales people. He established that Bio feedback and counselling enhanced performance of sales personnel.

Barnett (2004) conducted a research on work hours and stress outcomes among 211 dual income earner couples with children. He found that long hours of work had an effect on marital quality, psychological distress and work- family conflict. He proposed further research on the linkages both individually and within couples between long working hours and health behaviours such as regular exercises, routine medical checkups and healthy eating.

In Kenya a lot of research on causes of workers stress in educational institutions had focused on teachers. Gathungu and Wachira (2013) carried out a study on the job satisfaction factors that influence the performance of secondary school principals in their administrative functions in Mombasa district, Kenya. They found out that the determinants of stress include job satisfaction, job enhancement, team work, promotion, cooperation, mentoring and training needs, the development, management and recognition of success.

Yambo, et al. (2012) focused on investigating high school principals' stress in relation to their job experience in schools in Southern Nyanza Region of Kenya. They found out that the sources of stress: Role Based, Task Based, Conflict Mediating and Boundary Spanning had a correlation and dependable relationship with High School Principals' job Experience in schools.

Mairura (2009) conducted a research on counselling, self-esteem and stress among 130 teenagers in Nairobi day schools. He found that counselling was effective in managing stress experienced by teenagers and raised their self-esteem. He suggested further research on the same area, expanding the approach to include a larger or more representative sample.

Obwogi (2011) conducted a research on the factors that affect quality of teaching staff in universities in Kenya supplementing Ngoma's research in 2010 on the massive growth of university education in East Africa and the challenges facing the sector from 2000 to 2011. From both studies it's clear that something is not right among the university workers and something needs to be urgently done even as the work load increases in the public universities.

In response to the issue of universities workers problems, Muceke (2012) observed that most of the studies on academic staff retention were based on the corporate sector. There was only one from the public universities done by Tettey in 2009. Muceke (2012) noted the problem of academic staff retention in Kenyan public universities is a pertinent issue and it is expected to be worse with the double intake in 2011/2012 academic year. Musyoka et al (2013) in their research on the role of stress management in reducing stress and enhancing corporate performance concluded that the Government of Kenya is responsible for all workers through the ministry of labour. It has the duty to set regulations on minimum pay, health and safety of workers among others. They suggest that FKE and COTU should

come-up with regulations that will prevent or manage stress. They further suggest that Human Resources Manager who works in these corporations must be able to handle traumatic incidents, mediate conflict situations at work and organize for drug-alcohol abuse programmes for the staff. Getting in touch with employees brings the important aspect of social support which helps employees improve their perception and realize that they are valued, and in turn enhances their self-esteem and confidence at the work place. This translates to higher job performance among employees and is reflected by improvement of the measures of corporate performance such as customer satisfaction, employee creativity, productivity, higher market share and profitability. Critical to organizations supportive culture is sensitizing supervisors to be sympathetic to employees desire to seek balance between work and family needs. Finally managers should organize seminars for employees to educate them on time management, financial management, team work enhancing programmes and healthy living seminars in order to manage their own stress.

III. RESEARCH METHODOLOGY

The study adopted both exploratory and descriptive research designs. Creswell (2014) argues that a flexible research design which provides opportunity for considering many different aspects of a problem is considered if the purpose of the research study is that of exploration. When the purpose happens to be an accurate description of a situation or of an association between variables, the suitable design will be one that minimizes bias and maximizes the reliability of the data collected and analyzed (Kothari, 2004). Given this advice and the nature of this study, a non-experimental hypothesis testing design was adopted as most appropriate for this study. The study sought personal views, opinions, attitudes, and perceptions about causes of workers stress and their effect on the performance of the public universities which could be subjected to experimental design (Silverman, 2013).

The research design used for the study was a cross-sectional evaluation survey. This study collected information from workers in selected universities in Kenya thus making a survey effective in executing the research. An evaluation on the other hand involves the study of an organizational change, curriculum or innovation (Robert, 2002), which involved the evaluation of workers stress causative factors in public universities. However, the survey was cross-sectional survey since the data was collected at one particular time across the selected universities (Schurink, 2009). This research design was applied by the use of both suitable qualitative and quantitative research methods.

Quantitative research makes use of questionnaires, surveys and experiments to gather data that is revised and tabulated in numbers, which allows the data to be characterized by the use of statistical analysis (Denzin and Lincoln, 2005). Quantitative researchers measure variables on a sample of subjects and express the relationship between variables using effect statistics such as correlations, relative frequencies, or differences between means; their focus is to a large extent on the testing of theory. The study intended to establish the relationship between motivation and workers' stress. The factors were tabulated in the questionnaires and expressed using relative frequencies.

On the other hand, Creswell (2014) points out that there are several common characteristics of qualitative research, which includes: the data is collected in the field at the natural setting; researcher is a key instrument and they also use multiple forms of data collection such as interviews, observations, and documents rather rely on a single data source. This study employed qualitative research while generating data from specific participants on causes and effects of stress on performance and their coping strategies using interviews.

The target population refers to the subjects who possess attributes which the researcher wishes to study and a universe of units from which the sample is to be drawn Devos (2000). Bless and Higson-Smith (1995), define a target population as a set of elements on which the researcher focuses and from which the results obtained by testing the sample can be generalized.

The target population for this study was the staff of three selected public universities in Kenya. This included Jomo Kenyatta University of Agriculture and Technology, University of Nairobi, and Kenyatta University. This refers to the individual workers; in all levels of employment, at the selected higher institutions as well as representatives from the staff welfare department and the institutions' administration in charge of human resources. Various departmental heads are also targeted as their responsibilities from time to time involve human resources management. This gave a total target population of 12,805 workers from the three selected public universities as shown on table 3.1 below.

Table 3.1: Population of Workers in the Selected Public Universities

Selected public universities	University workers population
Jomo Kenyatta University of Agriculture and Technology	2,131
University of Nairobi	4,874
Kenyatta University	5,800
TOTAL	12,805

Source : (KUSU, 2014)

Cluster sampling technique was employed for the survey. The cluster sampling design involves the dividing of the population into mutually exclusive groups and then drawing random samples from each group to interview (Kumar R, 2005). This was necessary so as to ensure that the samples selected from each group are represented in the entire sample, which was selected for the study, in proportion to their numbers in the entire targeted population.

The Fishers formula was used to determine the appropriate sample size of this study. This was because the target population consists of a large number of units (public university workers) (Yates, 2004). The researcher assumed 95% desired level of confidence, which is equivalent to standardized normal deviate value of 1.96, and an acceptable margin of error of 5% (standard value of 0.05).

$$n = Z^2pq/d^2$$

Where:

n = the desired sample size (if target population is large)

z = the standard normal deviate at the required confidence level.
P = the proportion in the target population estimated to have characteristic being measured.

q = 1-p

d = the level of statistical significance set.

Assuming 50% of the population have the characteristics being measured, q=1-0.3

Assuming we desire accuracy at 0.05 level. The Z-statistic is 1.96 at this level

$$\text{Therefore } n = (1.96)^2(.5)(.5)/(0.05)^2 = 384$$

The targeted respondents from the selected public universities were categorized into three groups. These groups will include: The academic staff; the administrative staff; and the operative staff.

The cluster samples from the three selected universities were composed of respondent workers as shown on table 3.2.

Table 3.2: Composition of the Cluster Samples

Selected Universities	Public	Academic staff		Administrative staff		Operative staff		Total Respondents	
		Actual	Cluster	Actual	Cluster	Actual	Cluster	Actual	Cluster
JKUAT		702	21	923	28	506	15	2,131	64
University of Nairobi		1,411	42	1,647	49	1,816	55	4,874	146
Kenyatta University		900	27	1,700	51	3,200	96	5,800	174
GRAND TOTAL		3,013	90	4,270	128	5,522	166	12,805	384

The data collection tools used for the study were a questionnaire and interview schedules to obtain data from primary sources and a document review and analysis for

secondary sources. These tools were selected after carefully considering the nature of the data to be collected, the target

population, the time frame and the objectives/ research questions of the study.

a) Interviews

Interviews were important in situations where we cannot observe behaviour or when we do not know how participants experience their world (Cohen et al., 2007). Face-to-face interviews allowed the researcher an opportunity to explore the meaning participants attach to their experiences (Richards, 2003) in causes of their stress and how they are coping with such stress situations. Face-to-face interview as well allowed the researcher to observe non-verbal cues and appropriately react or modify his inquiry in response to non-verbal cues (Yin, 2003) of participants particularly when they elicit confusion, uncertainty, or waning motivation.

The interviews were based on a prepared set of questions but these were only used as a guide. The research took the same position as Silverman (2013), that in qualitative study, questions are only used as a guide and departures from the guidelines are not seen as a problem but are often encouraged. The interview schedules involved the interviews of some key informants from the selected institutions of higher learning who are in one way or another involved in the welfare of the workers.

b) Questionnaires

Questionnaire has the advantage of being taken to a wider audience compared to interviews, but has a disadvantage of not being possible to customize it to individuals as it is possible with other methods of data collection. The questionnaire was the main data collection tool and it contained both open ended and closed ended questions. This study used two questionnaires that included: Self-evaluation of the determinants of workers' stress (Appendix 1) which was taken by participants in the pilot as well as the actual study to investigate the causes and effects of occupational stress among university workers; this questionnaire also attempted to determine their attitude towards such factors; and Self-evaluation of the effects of the stress factors on their performance and coping strategies employed by the workers in dealing with their stress and stressful situation, was taken by the participants during the actual study.

Primary data was gathered using interview guides and questionnaires which were self-administered. Cooper & Schindler (2004) state that self-administered interviews help to reach a large number of potential respondents in different locations. The questionnaires also helped to collect data from a large population of respondents at a short period of time.

The questionnaire and interview schedule were used to obtain both qualitative and quantitative data from the targeted respondents. Primary data collection was conducted by research assistants and me because of the different locations of institutions of higher learning. The data was collected over a period of one month to be able to meet the requirements of a cross-sectional survey. Secondary data was obtained from literature review and documents about workers stress in institutions of higher learning. The questionnaires with open ended questions on workers stress in public universities in Kenya were administered to selected workers representatives within the selected public universities in Kenya. This informed the second phase of data generation.

The second phase involved: a) administering questionnaires to the respondents who included university workers in the selected public universities; and b) conducting interviews with

some key informants from the selected institutions of higher learning who are in one way or another involved in the welfare of the workers by use of interview guides. The questionnaires and the interview guides contained questions on the major issues raised in first phase.

Kombo and Tromp (2006) posit that after constructing a research instrument or questionnaire the researcher should try it out on a small sample of the population. This way of pre-testing or piloting of the instrument enables the researcher to ensure that the questions measure what they are supposed to; that the wording is very clear and unambiguous; that the questions provoke the intended responses and the researcher was able to analyze and know whether the questions posed are skewed towards certain issues more than others.

The questionnaire was pretested before its administration to ensure validity and reliability of the data to be collected. Validity was determined by the use of face validity and content validity. Face validity tests if the questions appear to be measuring the intended sections. On the other hand, content validity tests whether all the important aspects of the sections are measured. This was done by first testing the instruments on 10% of the target population and reviewing the findings. Reliability of the responses was tested using the Cronbach alpha. Normally, α should be between 0.7 – 0.9 (Santos, 1999).

Data processing operations carried out included data editing/ cleaning and classification. Data editing/ cleaning is the examination of the collected data so as to detect omissions and errors and to correct them whenever possible. Data classification is the arranging of the collected data in classes or groups with common characteristics. The similar data was then tabulated before further analysis is conducted.

The tabulated data was then analyzed using both qualitative and quantitative techniques. Descriptive statistics was used for the analysis of the collected data, and this included parameters such as measures of central tendencies and the measure of dispersion. Inferential data analysis techniques such as regression and correlation analysis were also used to analyze the collected data. These parameters were used to determine and evaluate the relationships of the variables being measured. Data analysis and presentation of findings was carried out using statistical software which includes SPSS version 24 and Microsoft Excel. These software aided in the generation of suitable graphs, charts and tables which were used in drawing conclusions as well as presenting the research findings.

Regression is an important approach to modelling the relationship between the dependent variable (y) and one or more independent variable (x). A regression equation describes how the mean value of a response variable relates to specific values of the predictor variables (Bhattacharyya, 2011). The study used logistic regression analysis to test the statistical significance of the independent variables on the dependent variables.

Logistic regression is used to refer specifically to the problem in which the dependent variable is [binary](#), that is, the number of available categories is two (Hosmer and Stanley, 2000). The probabilities describing the possible outcomes of a single trial were modelled, as a function of the explanatory variables, using a [logistic function](#) (Hosmer and Stanley, 2000). Logistic regression was therefore used to measure the relationship between the categorical dependent variable and the

independent variables by using probability scores as the predicted values of the dependent variable (Agestri, 2002).

The study used Binomial logistic regression. Binomial logistic regression refers to the instance in which the observed outcome can have only two possible types (Greene, 2003). The outcomes were coded as "0" and "1", as this lead to the most straightforward interpretation. The target group, the workers whose performance is affected (referred to as a "case") were coded as "1" and the reference group, workers whose performance is not affected (referred to as a "non-case") was coded as "0".

Logistic regression was used for predicting binary outcomes rather than continuous outcomes. It takes natural logarithm off the odds (logit or log-odds) to create a continuous criterion. The logit of success was then fitted to the predictors using regression analysis (Howell, 2010). The results of the logit were converted back to the odds via the inverse of the natural logarithm. Although the observed variables in logistic regression are categorical, the predicted scores were modelled as a continuous variable (the logit). The logit is referred to as the *link function* in logistic regression – although the output in logistic regression is binomial and displayed in contingency table, the logit is an underlying continuous criterion upon which linear regression was conducted (Howell, 2010).

Faraway (2002), states that regression analysis is a statistical tool for the investigation of relationships between variables. Regression methods have become an integral component of any data analysis concerned with describing the relationship between a response variable and explanatory variables (Hosmer and Stanley, 2000).

The logistic regression equations for performance of workers being affected was expressed as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e \quad (3.1)$$

Where; Y = Performance of workers being affected.

β_0 = Is the constant or coefficient of intercept.

X_1 = Management stress.

X_2 = Movement stress.

X_3 = Motivation stress.

$\beta_1 \dots \beta_2$ = The corresponding coefficients for the respective independent variables.

β_3 = Corresponding coefficients for the moderating variable.

Regression analysis was used by Gathungu and Wachira (2013) who studied the job satisfaction factors that influence the performance of secondary school principals in their administrative functions in Mombasa district, and Obwogi (2011) who studied the factors that affect quality of teaching staff in universities in Kenya.

The study was guided by the independent variables of Management stress, Movement stress and Motivation stress. Working facilities stress was measured by evaluating respondent's opinions on the contribution of the physical facilities available on their environment and the working conditions on their workplace stress.

Management stress was measured based on the respondents' opinion on the contribution of organizational structure, ambiguity

of roles, and participation in decision-making on workers' stress. Movement stress was measured by determining the respondents' opinion on the contribution of job shifts, job transfers and replacements on workers stress while motivation stress was measured by assessing the contribution of under promotion, over promotion and Lack of job security on the stress of the workers. The dependent variable for the study was the performance of the selected public university workers. The workers performance was measured by assessing the physiological and psychological responses that are attributed to exposure to a stress factor.

IV. RESEARCH FINDINGS AND DISCUSSION

The most common internal consistency measure known as Cronbach's alpha (α) was used. It indicates the extent to which a set of test item can be treated as measuring a single latent variable (Cronbach, 1971); Cronbach's alpha reliability coefficient that ranges between 0 and 1. 0 implies that there is no internal reliability while 1 indicated perfect internal reliability. Cronbach's alpha reliability coefficient value of 0.7 or higher is considered sufficient (Sekaran, 2009). The recommended value of 0.7 was therefore used as a cut-off of reliability (Sekaran, 2009). Reliability results for all the set of variables in the questionnaires gave a cronbach alpha statistics of more than 0.7, thus the threshold value of 0.7 were met.

Table 4.1: Summary of Reliability Test

Variable	Cronbach's Alpha	N of Items
Motivation	.812	10-questions
Management	.884	11-questions
Employee performance	.832	13-questions

To evaluate motivation 10 survey items on five point likert scale were used. Almost all of the respondents (90%) agreed that they are encouraged to find new and better ways to do their work. More than three quarters (78%) of the respondents agreed that when they put extra effort in their work they can be appreciated. Almost three quarters (73%) of the respondents supported the statement that they are encouraged to take initiative in their work. My organization gives enough recognition and rewards for work well done were supported by 66% of the respondents. More than three quarters of the respondents (79%) agreed that creativity and innovation are valued at their organization. My department often holds social activities for motivation of staff members was agreed upon by 90% of the respondents.

Table 4.2: Motivation

Variable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am encouraged to find new and better ways to do my work	8%	2%	0%	41%	49%
When I put extra effort in my work I can be appreciated for this	0%	4%	17%	37%	42%
I am encouraged to take initiative in my work	0%	6%	21%	40%	33%
My organization gives enough recognition and rewards for work well done	4%	10%	18%	33%	34%
Creativity and innovation are valued at my organization	0%	2%	20%	39%	40%
My department often holds social activities for motivation of staff members	0%	0%	10%	31%	59%
It is easy to discuss or share personal problems with my boss or members of the department	0%	6%	21%	40%	33%
We are occasionally taken to trips for purposes of team building and reducing monotony at my department or section	4%	10%	18%	33%	34%
Promotion is based on performance	0%	2%	20%	39%	40%
Appraisals are regular and focused on personal development	8%	14%	17%	49%	12%

Segregation by respondent's University, great discrepancies in responses were not observed.

Table 4.3: Motivation

Variable	University			
	Total	JKUAT	UoN	KU
e1 I am encouraged to find new and better ways to do my work	4.2	4.2	4.2	4.2
e2 When I put extra effort in my work I can be appreciated for this	4.2	4.1	4.2	4.2
e3 I am encouraged to take initiative in my work	4.0	3.9	4.0	4.0
e4 My organization gives enough recognition and rewards for work well done	3.8	3.9	3.8	3.8
e5 Creativity and innovation are valued at my organization	4.2	4.3	4.2	4.1
e6 My department often holds social activities for motivation of staff members	4.5	4.5	4.5	4.5
e7 It is easy to discuss or share personal problems with my boss or members of the department	4.0	3.9	4.0	4.0
e8 We are occasionally taken to trips for purposes of team building and reducing monotony at my department or section	3.8	3.9	3.8	3.8
e9 Promotion is based on performance	4.2	4.3	4.2	4.1
e10 Appraisals are regular and focused on personal development	3.4	3.5	3.4	3.4
Average	4.0	4.1	4.0	4.0

Motivation in this study was evaluated using 10 items. The five point likert scale of (10) data items, was used to measure and determine the extent to which Motivation comprised of the desired outcomes. A correlation was first done on all the data items under Motivation and only those that significantly correlated to each other were further reduced into few principal components. Results from correlations showed that "I am

encouraged to take initiative in my work –e3", "Creativity and innovation are valued at my organization-e5", "My department often holds social activities for motivation of staff members-e6", "It is easy to discuss or share personal problems with my boss or members of the department-e7" and "Promotion is based on performance-e9" did not correlate with most of other items and were therefore eliminated before running factor analysis.

Table 4.4: Correlations of Motivation items

Statistic	e1	e2	e3	e4	e5	e6	e7	e8	e9	e10
e1 Pearson Correlation	1	-.233**	-.165**	-.243**	-.357**	-.181**	-.165**	-.243**	-.357**	.297**
Sig. (2-tailed)		.000	.002	.000	.000	.001	.002	.000	.000	.000
N	354	354	354	354	354	354	354	354	354	354
e2 Pearson Correlation	-.233**	1	.468**	.196**	-.011	.661**	.468**	.196**	-.011	-.178**
Sig. (2-tailed)	.000		.000	.000	.838	.000	.000	.000	.838	.001

	N	354	354	354	354	354	354	354	354	354	354
e3	Pearson Correlation	-.165**	.468**	1	.079	.005	.296**	1.000**	.079	.005	-.156**
	Sig. (2-tailed)	.002	.000		.139	.922	.000	.000	.139	.922	.003
	N	354	354	354	354	354	354	354	354	354	354
e4	Pearson Correlation	-.243**	.196**	.079	1	.178**	.003	.079	1.000**	.178**	-.260**
	Sig. (2-tailed)	.000	.000	.139		.001	.960	.139	.000	.001	.000
	N	354	354	354	354	354	354	354	354	354	354
e5	Pearson Correlation	-.357**	-.011	.005	.178**	1	.092	.005	.178**	1.000**	-.123*
	Sig. (2-tailed)	.000	.838	.922	.001		.083	.922	.001	.000	.021
	N	354	354	354	354	354	354	354	354	354	354
e6	Pearson Correlation	-.181**	.661**	.296**	.003	.092	1	.296**	.003	.092	-.170**
	Sig. (2-tailed)	.001	.000	.000	.960	.083		.000	.960	.083	.001
	N	354	354	354	354	354	354	354	354	354	354
e7	Pearson Correlation	-.165**	.468**	1.000**	.079	.005	.296**	1	.079	.005	-.156**
	Sig. (2-tailed)	.002	.000	.000	.139	.922	.000		.139	.922	.003
	N	354	354	354	354	354	354	354	354	354	354
e8	Pearson Correlation	-.243**	.196**	.079	1.000**	.178**	.003	.079	1	.178**	-.260**
	Sig. (2-tailed)	.000	.000	.139	.000	.001	.960	.139		.001	.000
	N	354	354	354	354	354	354	354	354	354	354
e9	Pearson Correlation	-.357**	-.011	.005	.178**	1.000**	.092	.005	.178**	1	-.123*
	Sig. (2-tailed)	.000	.838	.922	.001	.000	.083	.922	.001		.021
	N	354	354	354	354	354	354	354	354	354	354
e10	Pearson Correlation	.297**	-.178**	-.156**	-.260**	-.123*	-.170**	-.156**	-.260**	-.123*	1
	Sig. (2-tailed)	.000	.001	.003	.000	.021	.001	.003	.000	.021	
	N	354	354	354	354	354	354	354	354	354	354

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

The next table is used as to test assumptions; essentially, the Kaiser-Meyer-Olkin (KMO) statistic should be greater than 0.500 and the Bartlett's test should be significant (e.g. $p < .05$). The Kaiser-Meyer-Olkin of sampling adequacy was above the threshold of 0.5 (KMO=0.666) indicating that the sample size was adequate for the variables entered into analysis. The

Bartlett's Test of Sphericity was significant ($\chi^2=699.742$, $df=18$, $P<0.001$) showing that factor analysis using principal component was relevant for the data set and there were some relationships between the variables.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.666
Bartlett's Test of Sphericity	Approx. Chi-Square	699.742
	Df	18
	Sig.	.000

The table below shows the eigenvalues (variances of the principal components) associated with each linear component (factor) before extraction, and after extraction. The extraction

converged in two iterations with two significant components with Eigenvalues accounting for 69.554% of the variance explained.

Table 4.5: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.369	47.374	47.374	2.369	47.374	47.374	1.992	39.836	39.836
2	1.109	22.180	69.554	1.109	22.180	69.554	1.486	29.718	69.554
3	.829	16.581	86.135						
4	.693	13.865	100.000						
5	-9.185E-17	-1.837E-15	100.000						

Extraction Method: Principal Component Analysis.

Being above the threshold of 50% it indicated that the one-component factor model derived fitted the data appropriately. Items loading greater than 0.6 for the component combined to form the two principal components and the variables that clustered into them are shown in table below.

Table 4.6: Rotated Component Matrix

Variable	Component	
	1	2
e1	-.116	.748
e2	.068	-.655
e4	.985	-.166
e8	.985	-.166
e10	-.178	.665

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

The effect of motivation on performance was examined by calculating the correlations.

Table 4.7: Correlation between Motivation and performance

	Not depressed	Don't feel bored	Does the best possible job	Enjoy work	Job Commitment	Responsible at work	Motivated, productive and creative	Stress poor work	Stress reduces productivity	Employee morale	Serves customer efficiently	Productive work	Efficient service delivery
e1	.443**	.085	.012	.059	-.054	.071	.006	-.065	-.010	-.053	-.173**	-.118*	-.078
e2	.206**	-.032	-.017	.018	-.013	-.059	-.062	-.028	.044	-.007	.118*	.107*	.035
e3	.181**	-.047	-.102	.038	-.029	.001	-.046	-.020	-.009	.022	.094	.055	.109*
e4	-.097	.041	-.059	-.018	-.024	.014	-.001	.098	.047	.014	.016	.023	.065
e5	.314**	-.036	.018	-.007	-.032	-.047	.033	.043	-.084	.005	.032	.010	.030
e6	.278**	-.080	.016	.005	-.052	-.019	-.010	.058	.030	.031	.153**	.089	.013
e7	.181**	-.047	-.102	.038	-.029	.001	-.046	-.020	-.009	.022	.094	.055	.109*
e8	-.097	.041	-.059	-.018	-.024	.014	-.001	.098	.047	.014	.016	.023	.065
e9	-.314**	-.036	.018	-.007	-.032	-.047	.033	.043	-.084	.005	.032	.010	.030
e10	.171**	-.008	-.013	-.078	-.057	.118*	-.110*	-.025	-.042	-.075	-.020	-.032	.022

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Results showed that lack of depression and effective performance was significant at 0.01 level of significance on being encouraged to find new and better ways to do work (.443);

being appreciated when one put extra effort at work (.206); being encouraged to take initiative at work (.181) valuing creativity and innovation (.314); department often holding social activities for

motivation of staff members (.278); ease of discussing or sharing personal problems with the boss or members of the department (.181); promotion being based on performance (-.314) and appraisals being regular and focused on personal development (.171).

Ability to serve the customers efficiently was significantly correlated to being encouraged to find new and better ways to do work (-.173); being appreciated when one puts extra effort in their work (.118) and department often holding social activities for motivation of staff members (.153). Having efficient service delivery was significantly correlated to being encouraged to take initiative in work (.109) and ease of discussing or sharing personal problems with the boss or members of the department (.109).

To assess management respondents were presented with a list of statements on a five point likert scale and asked to rate their agreement with each. 51% of the respondents, agreed to be

aware of their organization structure. More than half of the respondents (54%) were either neutral or disagreed with the statement on their Organization Structure being appropriate. Most of the respondents (79%) agreed that people are held accountable for the quality of work they produce. Two thirds of the respondents agreed that their supervisor asks for their input to help make decisions. More than half of the respondents (59%) supported the statement that their supervisor tells them when they do their work well. However, most of the respondents (55%) disagreed with the statement that their supervisor tells them when their work needs improvement. More than two thirds (69%) of the respondents agreed that their supervisor delegates work effectively. On the other hand slightly more than half of the respondents (53%) felt adequately utilized in their job. Management is sensitive to employee problems was agreed upon by 53% of the respondents while another 57% agreed to being involved in decision making in their organization.

Table 4.8: Management

Variable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am aware of my Organization Structure	6%	20%	23%	39%	12%
The Organization Structure is appropriate	10%	19%	25%	32%	14%
People are held accountable for the quality of work they produce	6%	9%	6%	43%	36%
My supervisor asks for my input to help make decisions	2%	10%	21%	37%	30%
My supervisor tells me when I do my work well	4%	10%	27%	31%	28%
My supervisor tells me when my work needs improvement	12%	20%	23%	33%	12%
My supervisor delegates work effectively	2%	16%	12%	49%	20%
I feel adequately utilized in my job	4%	14%	29%	49%	4%
Management is sensitive to employee problems	8%	10%	28%	39%	14%
I am involved in decision making in my organization	8%	12%	23%	47%	10%

Segregation by respondent's University, great discrepancies in responses were not observed.

Table 4.9: Management by University

Variable	University			
	Total	JKUAT	UoN	KU
f1 I am aware of my Organization Structure	3.3	3.3	3.3	3.3
f2 The Organization Structure is appropriate	3.2	3.1	3.2	3.2
f3 People are held accountable for the quality of work they produce	3.9	3.9	4.0	4.0
f4 My supervisor asks for my input to help make decisions	3.8	3.8	3.8	3.8
f5 My supervisor tells me when I do my work well	3.7	3.8	3.7	3.7
f6 My supervisor tells me when my work needs improvement	3.1	3.2	3.1	3.1
f7 My supervisor delegates work effectively	3.7	3.6	3.7	3.7
f8 I feel adequately utilized in my job	3.4	3.4	3.3	3.3
f9 Management is sensitive to employee problems	3.4	3.5	3.4	3.4
f10 I am involved in decision making in my organization	3.4	3.3	3.4	3.4
Average	3.4	3.2	3.5	3.3

Management in this study was evaluated using 10 items. The five point likert scale of (10) data items, was used to measure and determine the extent to which management comprised of the desired outcomes. A correlation was first done on all the data items under management and only those that significantly correlated to each other were further reduced into

few principal components. Results from correlations showed that “The Organization Structure is appropriate-f2” and “f3 People are held accountable for the quality of work they produce-f3” did not correlate with most of other items and was therefore eliminated before running factor analysis.

Table 4.10: Correlations among management items

	Statistic	f1	f2	f3	f4	f5	f6	f7	f8	f9	f10
f1	Pearson Correlation	1	.208**	.013	.509**	.295**	.159**	-.139**	.443**	.466**	.180**
	Sig. (2-tailed)		.000	.806	.000	.000	.003	.009	.000	.000	.001
	N	354	354	354	354	354	354	354	354	354	354
f2	Pearson Correlation	.208**	1	-.049	.016	.009	.126*	.290**	-.089	.138**	.019
	Sig. (2-tailed)	.000		.355	.770	.871	.018	.000	.096	.009	.725
	N	354	354	354	354	354	354	354	354	354	354
f3	Pearson Correlation	.013	-.049	1	.378**	.091	.221**	.138**	.230**	.092	.342**
	Sig. (2-tailed)	.806	.355		.000	.089	.000	.009	.000	.083	.000
	N	354	354	354	354	354	354	354	354	354	354
f4	Pearson Correlation	.509**	.016	.378**	1	.424**	.310**	-.108*	.409**	.452**	.495**
	Sig. (2-tailed)	.000	.770	.000		.000	.000	.043	.000	.000	.000
	N	354	354	354	354	354	354	354	354	354	354
f5	Pearson Correlation	.295**	.009	.091	.424**	1	.097	-.173**	.329**	.356**	.323**
	Sig. (2-tailed)	.000	.871	.089	.000		.067	.001	.000	.000	.000
	N	354	354	354	354	354	354	354	354	354	354
f6	Pearson Correlation	.159**	.126*	.221**	.310**	.097	1	-.128*	.185**	.432**	.400**
	Sig. (2-tailed)	.003	.018	.000	.000	.067		.016	.000	.000	.000
	N	354	354	354	354	354	354	354	354	354	354
f7	Pearson Correlation	-.139**	.290**	.138**	-.108*	-.173**	-.128*	1	-.024	-.169**	-.010
	Sig. (2-tailed)	.009	.000	.009	.043	.001	.016		.649	.001	.854
	N	354	354	354	354	354	354	354	354	354	354
f8	Pearson Correlation	.443**	-.089	.230**	.409**	.329**	.185**	-.024	1	.168**	.115*
	Sig. (2-tailed)	.000	.096	.000	.000	.000	.000	.649		.002	.030
	N	354	354	354	354	354	354	354	354	354	354
f9	Pearson Correlation	.466**	.138**	.092	.452**	.356**	.432**	-.169**	.168**	1	.246**
	Sig. (2-tailed)	.000	.009	.083	.000	.000	.000	.001	.002		.000
	N	354	354	354	354	354	354	354	354	354	354
f10	Pearson Correlation	.180**	.019	.342**	.495**	.323**	.400**	-.010	.115*	.246**	1
	Sig. (2-tailed)	.001	.725	.000	.000	.000	.000	.854	.030	.000	
	N	354	354	354	354	354	354	354	354	354	354

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

The Kaiser-Meyer-Olkin of sampling adequacy was above the threshold of 0.5 (KMO=0.669) indicating that the sample size was adequate for the variables entered into analysis. The Bartlett’s Test of Sphericity was significant ($\chi^2=699.742$, $df=28$,

$P<0.001$) showing that factor analysis using principal component was relevant for the data set and there were some relationships between the variables.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.669
Bartlett's Test of Sphericity	Approx. Chi-Square	699.742
	Df	28
	Sig.	.000

The table below shows the eigenvalues (variances of the principal components) associated with each linear component (factor) before extraction, and after extraction. The extraction converged in three iterations with one significant component with Eigenvalues accounting for 64.812% of the variance explained.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% Variance	of Cumulative %	Total	% Variance	of Cumulative %	Total	% Variance	of Cumulative %
1	3.026	37.829	37.829	3.026	37.829	37.829	2.227	27.833	27.833
2	1.127	14.081	51.910	1.127	14.081	51.910	1.838	22.978	50.811
3	1.032	12.901	64.812	1.032	12.901	64.812	1.120	14.001	64.812
4	.847	10.583	75.394						
5	.711	8.889	84.283						
6	.598	7.479	91.762						
7	.375	4.682	96.444						
8	.284	3.556	100.000						

Extraction Method: Principal Component Analysis.

Being above the threshold of 50% it indicated that the one-component factor model derived fitted the data appropriately. Items loading greater than 0.5 for the component combined to form the one principal component and the variables that clustered into it are shown in table below. The third component comprised of one item which was eliminated further analysis.

Table 4.11: Rotated Component Matrix

Variable	Component		
	1	2	3
f1	.775	.103	-.172
f4	.661	.501	-.008
f5	.606	.210	-.162
f6	.024	.795	-.167
f7	-.060	-.011	.923
f8	.790	-.025	.127
f9	.405	.515	-.374
f10	.173	.797	.170

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 4 iterations.

The effect of management on performance and was examined by calculating the correlations.

Table 4.12: Correlation between management and performance

	Not depressed	Don't feel bored	Does the best possible job	Enjoy work	Job Commitment	Responsible for actions at work	Motivated and productive creative	Stress produces poor work	Stress reduces productivity	Employees have high morale	Serves the customer efficiently	Produce accurate work	Efficient service delivery
f1	.114*	.031	-.068	.008	.012	.056	-.027	-.046	.051	-.007	-.015	-.038	-.125*
f2	.152**	-.032	.092	.078	-.097	-.058	.096	-.041	.059	.051	-.091	-.036	-.138*
f3	.132*	-.016	-.008	-.035	.123*	.008	-.027	-.006	-.024	-.068	.003	.021	-.077
f4	.156**	.037	-.027	-.045	.021	.107*	-.018	-.057	.020	-.030	-.018	-.045	-.059
f5	.207**	.028	.001	-.064	.010	.098	-.068	-.014	-.097	-.095	-.084	-.093	-.110*
f6	.299**	.049	.082	.005	.078	.008	.069	-.042	-.070	.025	-.087	-.097	-.097
f7	.153**	-.091	.008	.025	-.033	-.003	.014	-.018	.045	.037	.000	.013	.072
f8	.019	-.077	-.036	-.084	-.016	.006	-.101	-.029	-.073	-.028	.126*	.073	.022
f9	.057	.133*	.011	.054	.045	.074	.123*	-.039	.034	-.047	-.216**	-.150**	-.178**
f10	.088	.060	.113*	-.002	.042	.165**	-.015	-.043	.023	-.030	-.126*	-.170**	-.081

*. Correlation is significant at the 0.05 level (2-tailed).

** . Correlation is significant at the 0.01 level (2-tailed).

Results showed that lack of depression and effective performance was positively and significantly correlated to being aware of Organization Structure (.114); organization Structure being appropriate (.152); People being held accountable for the quality of work they produce (.132); supervisor asking for employees' input to help make decisions (.156); supervisor telling employees when they do my work well(.207); supervisor telling employees when their work needs improvement (.299); and supervisor delegating work effectively (.153).

Being committed to their jobs was positively and significantly correlated to People being held accountable for the quality of work they produce (.123). Taking responsibility for our actions within the job environment was positively and significantly correlated to supervisor asking for employees' input to help make decisions (.107) and being involved in decision making in their organization (165). Having efficient service delivery was significantly correlated to being aware of organization structure (-.125) and organization Structure being appropriate (-.138).

To evaluate employee performance, respondents were presented with 13 statements on five point likert scale and asked to rate their agreement with each statement. From the results

most of the respondents (74%) agreed that they are not aggressive and depressed at work and therefore can perform duties effectively. Slightly over half of the respondents (55%) agreed that they do not always feel lazy, boredom and headache lowering their output. Surprisingly more than two thirds of the respondents (68%) agreed to not doing their best possible job. Over half of the respondents (53%) agreed that they enjoy their work. We are committed to our jobs was supported by 53% of the respondents. Most of the respondents (63%) disagreed that they take responsibility for their actions within the job environment. More than three quarters of the respondents (80%) admitted to being always motivated, productive and creative. Stress makes me produce poor quality work was agreed upon by 85% of the respondents while 81% agreed that stress reduces their productivity at work. On the other hand 60% of the respondents disagreed that employees in their University have high morale or commitment. Most of the respondents (57%) disagreed that they are able to serve the customers efficiently while 53% disagreed to being able to produce accurate work as expected by their organization. We have acquired efficient service delivery and quality of services in this University was disagreed by 60% of the respondents.

Table 4.13: Employee Performance

Variable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am not aggressive and depressed at work and therefore can perform my duties effectively	7%	8%	12%	34%	40%
I do not always feel lazy, boredom and headache lowering my output	0%	8%	37%	31%	23%
You do not do the best possible job	5%	11%	16%	40%	28%
I enjoy my work	11%	17%	19%	34%	19%
We are committed to our jobs	12%	15%	21%	43%	10%

We take responsibility for our actions within the job environment	18%	26%	19%	21%	16%
We are always motivated, productive and creative	0%	5%	16%	51%	29%
Stress makes me produce poor quality work	1%	1%	13%	53%	32%
Stress reduces my productivity at work	0%	5%	15%	53%	28%
Employees in this University have high morale or commitment	4%	31%	25%	28%	12%
I am able to serve the customers efficiently	17%	18%	22%	33%	10%
I am able to produce accurate work as expected by my organization	14%	14%	26%	39%	8%
We have acquired efficient service delivery and quality of services in this University	13%	22%	24%	28%	12%

To provide a comparative description for the responses obtained as shown below. Great discrepancies among the across the three universities, the average for each statement were respondents from the three universities were not observed.

Table 4.14: Employee Performance

Variable	Total	University		
		JKUAT	UoN	KU
g1 I am not aggressive and depressed at work and therefore can perform my duties effectively	3.9	4.0	4.0	3.8
g2 I do not always feel lazy, boredom and headache lowering my output	3.7	3.6	3.7	3.7
g3 You do not do the best possible job	3.8	3.2	3.8	3.9
g4 I enjoy my work	3.3	3.3	3.2	3.5
g5 We are committed to our jobs	3.2	3.2	3.3	3.2
g6 We take responsibility for our actions within the job environment	2.9	2.8	2.8	3.0
g7 We are always motivated, productive and creative	4.0	4.0	4.0	4.1
g8 Stress makes me produce poor quality work	4.1	4.1	4.1	4.2
g9 Stress reduces my productivity at work	4.0	4.0	4.0	4.1
g10 Employees in this University have high morale or commitment	3.1	3.0	3.1	3.2
g11 I am able to serve the customers efficiently	3.0	3.2	3.1	2.9
g12 I am able to produce accurate work as expected by my organization	3.1	3.2	3.2	3.0
g13 We have acquired efficient service delivery and quality of services in this University	3.0	2.9	3.0	3.1
Average	3.4	3.2	3.4	3.5

Factor analysis for Employee Performance

Employee Performance in this study was evaluated using 13 items. The five point likert scale of (13) data items, was used to measure and determine the extent to which Employee Performance comprised of the desired outcomes. A correlation was first done on all the data items under Employee Performance and only those that significantly correlated to each other were further reduced into few principal components. Results from correlations showed that “I am not aggressive and depressed at work and therefore can perform my duties effectively-g1”, “You do not do the best possible job-g3”, “We are committed to our jobs-g5”and “ Stress reduces my productivity at work-g9” did

not correlate with most of other items and was therefore eliminated before running factor analysis, Table 4.67 in the appendix.

The Kaiser-Meyer-Olkin of sampling adequacy was above the threshold of 0.5 (KMO=0.540) indicating that the sample size was adequate for the variables entered into analysis. The Bartlett’s Test of Sphericity was significant ($\chi^2=646.288$, $df=36$, $P<0.001$) showing that factor analysis using principal component was relevant for the data set and there were some relationships between the variables.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.540
Bartlett's Test of Sphericity	Approx. Chi-Square	646.288
	Df	36
	Sig.	.000

The table below shows the eigenvalues (variances of the principal components) associated with each linear component (factor) before extraction, after extraction and after rotation. The rotations converged in four iterations with four significant components with Eigenvalues accounting for 62.319% of the variance explained.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% Variance	% of Cumulative	Total	% Variance	% of Cumulative	Total	% Variance	% of Cumulative
1	2.311	25.673	25.673	2.311	25.673	25.673	2.027	22.521	22.521
2	2.010	22.331	48.004	2.010	22.331	48.004	1.822	20.245	42.766
3	1.288	14.315	62.319	1.288	14.315	62.319	1.760	19.553	62.319
4	.943	10.477	72.796						
5	.755	8.386	81.183						
6	.630	6.995	88.178						
7	.526	5.849	94.027						
8	.310	3.443	97.470						
9	.228	2.530	100.000						

Extraction Method: Principal Component Analysis.

Being above the threshold of 50% it indicated that the two-component factor model derived fitted the data appropriately. Items loading greater than 0.6 for each component, except for

e11, combined to form the four principal components and the variables that clustered into each are shown in table below.

Table 4.15: Rotated Component Matrix

Variable	Component		
	1	2	3
g2 I do not always feel lazy, boredom and headache lowering my output	-.225	.731	-.009
g4 I enjoy my work	-.171	-.094	.772
g6 We take responsibility for our actions within the job environment	-.467	.309	-.553
g7 We are always motivated, productive and creative	-.085	.451	.638
g8 Stress makes me produce poor quality work	.079	.684	-.034
g10 Employees in this University have high morale or commitment	.161	.553	.574
g11 I am able to serve the customers efficiently	.886	-.021	-.134
g12 I am able to produce accurate work as expected by my organization	.873	.029	-.002
g13 We have acquired efficient service delivery and quality of services in this University	.376	.452	.320

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Linear Regression analysis was employed to predict Employee performance from Worker's motivation. Model summary shows the coefficient of determination (R^2) which tells us the percentage of the variation in Employee performance explained by the model. From the results of the table below, the regression model containing Worker's motivation as the independent variable explains 11.2% of the variation in

Employee performance. The size of Durbin Watson statistic which depends on the number of predictors and number of observation, as conservative rule of thumb, values less than 1 or greater than 3 are definitely cause for concern. Durbin-Watson value of 1.694 indicates that the model did not suffer significantly from autocorrelation.

Table 4.16: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.334 ^a	.112	.109	.48785	1.694

a. Predictors: (Constant), Worker’s motivation

b. Dependent Variable: Employee performance

The table below displays ANOVA results that test the significance of the R² for the model. An F statistics of 44.184 with a p-value less than the conventional 5% indicates that the overall model was significant at 95% confidence level.

Table 4. 17: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.516	1	10.516	44.184	.000 ^a
	Residual	83.777	352	.238		
	Total	94.293	353			

a. Predictors: (Constant), Worker’s motivation

b. Dependent Variable: Employee performance

In order to detect whether multicollinearity was a problem to the model, condition index; the variance-inflation factor (VIF); and tolerance of each variable was calculated. VIF values are considered a problem when they go beyond 10, and tolerance values below .10 should be a cause for concern. A condition index over 30 suggests serious collinearity problems and an index over 15 indicates possible collinearity problems. The data were duly tested for multicollinearity by using Pearson’s correlation and conditional index. The Table below, showed no serious problem of multicollinearity.

Table 4. 18: Collinearity Diagnostics

Model	Dimension	Eigenvalues	Condition Index	Variance Proportions	
				(Constant)	Worker’s motivation
1	1	1.987	1.000	.01	.01
	2	.013	12.326	.99	.99

a. Dependent Variable: Employee performance

Table of coefficients below presents the unstandardized and standardized coefficients of the model, the t statistic for each coefficient and the associated p-values. The predictor variable had significant positive relationship with Employee performance. The findings confirm that there is a statistically significant influence of Worker’s motivation on Employee performance.

This implies that an increase in Worker’s motivation leads to an increase in Employee performance as demonstrated by the equation below.

$$\text{Employee performance} = 2.358 + .277 \text{Worker's motivation}$$

Table 4.19: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients		Collinearity Statistics		
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1 (Constant)	2.358	.161		14.658	.000		
Worker’s motivation	.277	.042	.334	6.647	.000	1.000	1.000

a. Dependent Variable: Employee performance

Linear Regression analysis was employed to predict Employee performance from Management. Model summary shows the coefficient of determination (R²) which tells us the percentage of the variation in Employee performance explained by the model. From the results of the table below, the regression

model containing Management as the independent variable explains 23.9% of the variation in Employee performance. The size of Durbin Watson statistic which depends on the number of predictors and number of observation, as conservative rule of thumb, values less than 1 or greater than 3 are definitely cause

for concern. Durbin-Watson value of 2.614 indicates that the model did not suffer significantly from autocorrelation.

Table 4.20: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.489 ^a	.239	.237	.45144	2.614

a. Predictors: (Constant), Management

b. Dependent Variable: Employee performance

The table below displays ANOVA results that test the significance of the R² for the model. An F statistics of 110.676 with a p-value less than the conventional 5% indicates that the overall model was significant at 95% confidence level.

Table 4. 21: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22.556	1	22.556	110.676	.000 ^a
	Residual	71.737	352	.204		
	Total	94.293	353			

a. Predictors: (Constant), Management

b. Dependent Variable: Employee performance

In order to detect whether multicollinearity was a problem to the model, condition index; the variance-inflation factor (VIF); and tolerance of each variable was calculated. VIF values are considered a problem when they go beyond 10, and tolerance values below .10 should be a cause for concern. A condition

index over 30 suggests serious collinearity problems and an index over 15 indicates possible collinearity problems. The data were duly tested for multicollinearity by using Pearson's correlation and conditional index. The Table below, showed no serious problem of multicollinearity.

Collinearity Diagnostics

Model	Dimension	Eigenvalues	Condition Index	Variance Proportions	
				(Constant)	Management
1	1	1.976	1.000	.01	.01
	2	.024	9.050	.99	.99

a. Dependent Variable: Employee performance

Table of coefficients below presents the unstandardized and standardized coefficients of the model, the t statistic for each coefficient and the associated p-values. The predictor variable had significant positive relationship with Employee performance.

The findings confirm that there is a statistically significant influence of Management on Employee performance. This implies that an increase in Management leads to an increase in Employee performance as demonstrated by the equation below.
Employee performance= **2.285 + .402Management**

Table 4.22: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients		Collinearity Statistics		
	B	Std. Error	Beta	T	Sig.	Tolerance	VIF
1 (Constant)	2.285	.110		20.792	.000		
Management	.402	.038	.489	10.520	.000	1.000	1.000

Multivariate linear Regression analysis was employed to predict Employee performance from the joint contribution of Motivation and Management. Model summary shows the coefficient of determination (R²) which tells us the percentage of the variation in Employee performance explained by the model.

From the results of the table below, the regression model containing Motivation and Management as the predictor variables explains 61.0% of the variation in Employee performance. The size of Durbin Watson statistic which depends on the number of predictors and number of observation, as

conservative rule of thumb, values less than 1 or greater than 3 are definitely cause for concern. Durbin-Watson value of 1.851 indicates that the model did not suffer significantly from autocorrelation.

Table 4.23: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.781 ^a	.610	.582	.02779	1.851

b. Dependent variable: employee performance

The table below displays ANOVA results that test the significance of the R² for the model. An F statistics of 57.717 with a p-value less than the conventional 5% indicates that the overall model was significant at 95% confidence level.

Table 4. 24: ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	31.687	3	10.562	57.717	.000 ^a
Residual	62.037	339	.183		
Total	93.724	342			

a. Predictors: (Constant), workplace facilities, Worker’s relationship , Worker’s movement

b. Dependent Variable: employee performance

Table of coefficients below presents the unstandardized and standardized coefficients of the model, the t statistic for each coefficient and the associated p-values. The predictor variables had significant positive relationship with Employee performance except motivation.

The findings confirm that there is a statistically significant influence of Worker’s Management on Employee performance.

This implies that unit increase in Worker’s relationship, Worker’s movement, Workplace facilities and Management leads to an increase in Employee performance as demonstrated by the equation below.

$$\text{Employee performance} = 2.286 + .096 \text{ Management}$$

Table 4.25: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1 (Constant)	2.286	.344		6.637	.000		
Motivation	.009	.049	.009	.187	.851	.914	1.094
Management	.096	.045	.135	2.135	.033	.488	2.047

a. Dependent Variable: Employee performance

On the influence of workers’ motivation on Employee motivation, the findings confirm that there is a statistically significant influence of Worker’s motivation on Employee performance. This implies that an increase in Worker’s motivation leads to an increase in Employee performance as demonstrated by the equation below.

$$\text{Employee performance} = 2.358 + .277 \text{ Worker's motivation}$$

The above findings postulate that lack of motivation among employees may lead to stress that is negatively related to performance. However provision of motivation will come a long way in minimising stress and improving performance of the employees. These results are similar to previous studies which indicated that motivation of employees in an organisation which

largely emanates from access to financial rewards, good pay and incentives will reduce stress and improve workers performance. White (2006) found out that when employees think that they are not rewarded according to the efforts they are putting in; it creates stress among them and therefore their work performance decreases. Additionally, Giga (2011) also found out that effective motivation can create a productive work force, but a lack of motivating factors can leave employees searching for reasons to give their maximum effort.

On the influence of management on employee performance, the findings confirm that there is a statistically significant influence of Management on Employee performance. This implies that an increase in Management leads to an increase in Employee performance as demonstrated by the equation below.

Employee performance= 2.285 + .402 Management

Following from these results, employees will perform better in an environment where they consider the management to be positive either in supporting them or in their management. Efficiency in management leads to positive employee performance. These results echo past studies which indicated that poor management of work leads to workplace stress and reduce the performance of the workers. Bashir (2010) found out that role conflict makes the employee incompatible to complete well his or her job task and this causes job stress. Dar et al. (2011) also found out that performance is hindered by job description conflict because with it the individual faces either a lack of knowledge about the most effective behaviours to engage in or an almost impossible situation for doing everything expected. The findings also supports those of Robbins et al. (2009) who found out that workload can lead to severe stress which can have insalubrious effect on the lives of employees, which can lead to reduced effectiveness, less inspiration and increase in non-appearance in office.

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

Employees in institutions of higher education have a major role to play in achieving the objectives of the institution. The performance of the staff, both as teachers, researchers and managers, determines to a large extent, the quality of the student experience of higher education and has a significant effect on student learning and thereby on the contribution that such institutions can make to society. Responsibility for others is often associated with significant occupational stress. Each of the sources of stress that were assessed in this study was found to be significant and that each is a strong determinant of performance of the employees in the public universities and therefore should be given attention.

Motivation involves the ability to make somebody want to do something especially something that involves hard work. In a university work environment, employees will feel motivated to do their work effectively and efficiently if they are rewarded accordingly and are given an opportunity to participate in decision making. Reward does not only involve salaries but other sources of remuneration such as gifts and awards as well as opportunities for promotion. The reward however needs to be fair or at least employees need to perceive the reward to be fair. The stress 'salary not as good as other people doing similar work' is connected to two key expectations that employees have when they begin employment with an organization; that they will be treated fairly and that they will be recognized for the work they do.

Additionally, employees will feel motivated to work within the public universities and hence minimise cases of stress at the workplace, if they are exposed to policies and procedures that appear to not to discriminate unfairly between employees, or tend to value some employees more than others. The results also indicate that when public university workers are able to ascertain that within the organisation there are financial incentives, involvement in decision making, and a career path that leads to management, the cases of stress and subsequently poor performance is minimised.

Results of the study indicate that while workers in public universities perceive the organisations as offering them motivation by: being appreciated when they put extra effort at work; department often holding social activities for motivation of staff members; and, promotion being based on performance, motivation among public university workers is still a major source of stress that undermines their performance.

Management in this study refers to how the organization supervisors or leaders assign roles to their subordinates and how effectively those roles are assigned to enhance productivity. Working in a large, hierarchical, bureaucratic organization where employees have little control over their jobs can be very stressful. Additionally, when there is a high concentration of assignments at work: excessive work or work that is outside one's capability, employees gets stressed and perform poorly.

Since in management supervisors hold each employee accountable to their actions and duties, and for the quality of work they produce, role conflict that relates with mismatched role potentials, and role ambiguity which explains the uncertainty of what is expected, leads to stress and eventually interferes with the performance of the university workers.

Respondents were neutral on the statement of whether they were not depressed at work and therefore can perform their duties effectively. Respondents did not also know how to rate whether they felt always lazy, bored and headache lowering their output. Most of the respondents felt that they did not do the best possible job. However, most of the respondents enjoy their work and are committed to it.

Keeping in view the important role of university workers in ensuring that the institution achieves its objectives of sustaining economic and social development of the country, the concept of university workers performance has achieved a strategic significance. The performance of university workers is affected by intra as well as extra organizational factors, which act as impediments to normal routine functioning of the workers. Once the routine functioning of the workers is disrupted, then the university workers develop feelings of exhaustion and frustration, and if the disrupted situation persists then negative dysfunctional feelings hit the workers which can be termed as stress, which is a reaction to the unwanted environmental stressors.

Workers under stress cannot perform well. Their job satisfaction and motivation levels are decreased and they show unwanted behaviours like absenteeism, mistakes during work, drugs use and abuse and violence at work. Furthermore they have more health related physical and psychological complaints. The university employees' satisfaction level is also decreased in such way that the university cannot offer quality education to the students. The resultant effect include complaints from parents and other stakeholders on the status of service delivery at the institutions, frequent strikes, dissatisfied employees and poor performance of the universities in general, and eventually overall image of the educational institution gets damaged.

Motivation involves the ability to make somebody want to do something especially something that involves hard work. In public universities, there is a lot of work as depicted by the results of the study and therefore motivating employees will ensure that they are committed to delivering on their duties. When employees feel motivated to work within the public

universities there will be minimal cases of stress at the workplace leading to positive performance. Effective motivation creates a productive work force, but a lack of motivating factors can leave employees searching for reasons to give their maximum effort. In conclusion the findings confirm that there is a statistically insignificant influence of Worker's motivation on employee performance.

The management of public universities is responsible for ensuring that there are smooth operations within the institution. This calls for ensuring that employees are effectively and efficiently assigned roles that are in line with their abilities to perform. When employees are subjected to a high concentration of assignments at work: excessive work or work that is outside one's capability, employees get stressed and perform poorly. Additionally cases of role ambiguity and role conflict can minimise the ability of the employees to deliver of their roles effectively. As such their performance and productivity will be lowered. It hence follows that poor management exposes the employees to stress, reducing their performance. Conclusively the study confirms that there is a statistically significant influence of management on employee performance. This implies that a positive increase in management score leads to an increase in employee performance.

This study has some limitations. It confined its focus to three universities only. Hence, future research should examine the effects of occupational stress affecting the performance of employees incorporating most of the universities in Kenya. This study and its findings should be viewed as a starting point for more extensive research related to determinant and effects of occupational stress.

Research on other variables presumed related, either directly or indirectly to employee performance should be researched on. Whereas this research has relied on quantitative approaches to examine the effects of occupational stress affecting the performance of employees, an in-depth analysis of individual responses can generate useful inductive information and provide a richer understanding of the factors important in predicting occupational stress affecting the performance of employees.

REFERENCES

- [1] Addae H.M., Parbooteah K.P. and Velinor N. (2008), Role stressors and organizational commitment: Public sector employment in St. Lucia, *International Journal of Manpower*, 26(6), 567-582
- [2] Addae H.M., Parbooteah K.P. and Velinor N. (2008), Role stressors and organizational commitment: Public sector employment in St. Lucia, *International Journal of Manpower*, 26(6), 567-582
- [3] Akbar, A. (2011). Faculty Stress at Higher Education: A Study on the Business Schools of Pakistan: *World Academy of Science, Engineering and Technology*, 1082.
- [4] Al-Aameri S. (2003). "Source of job stress for nurses in public hospitals": *Saudi Medical Journal*, 4(11), pp.1183- 1187.
- [5] Alexandros-Stamatios G. A.et al, (2003), "Occupational Stress, Job satisfaction, and health state in male and female junior hospital doctors in Greece", *Journal of Managerial Psychology*, 18(6), pp. 592-621
- [6] Allen et al (2000), "Consequences Associated with Work Family conflict: a review and Agenda for future Research"; *Journal of occupational Health Psychology* vol. 5 Pg. 278-308.
- [7] Arnold B.et al (2007), Job resources boost work engagement, particularly when job demands are high, *Journal of Educational Psychology*, 99(2), 274-284.
- [8] Aryee, S. et al (1998), "Family Response variables and Retention Relevant outcomes among Employed Parents." *Human Relations* vol. 51 Pg. 73-87.
- [9] Bachkirova, T., (2005), Teacher stress and personal values: An exploratory study. *School Psychology International*, 26(3), 340-352.
- [10] Balt, R. & Valcour, M., (2003), "Human Resource Practices as predictors of work family outcomes and Employee Turnover" *Industrial Relations*. Vol. 42 Pg. 189-220.
- [11] Barling, et al (2004), *Handbook of work stress: New York, USA*.
- [12] Barnett, R.C., (2004) "Work hours as a predictor of stress outcomes" paper presented at a conference towards a National Research agenda: University of Maryland.
- [13] Barsky, A., et al (2004), "Modelling Negative Affectivity and job stress: A contingency Approach." *Journal of Organizational Behaviour*, vol. 36, pg. 915-936.
- [14] Bashir, U. (2010), Impact of Stress on Employees Job Performance: A Study on banking Sector of Pakistan; *International Journal of marketing Studies*, Vol. 2, 122.
- [15] Beehr, T. A. (2005), *Psychological Stress in the Workplace*, London and New York.
- [16] Betoret T., (2006) Stressors, self-efficacy, coping resources and burnout among secondary school teachers in Spain, *Educational Psychology*, 26(4), 519-539.
- [17] Blomme, R.J., et al (2010), Work-family conflict as a cause for turnover intentions in the hospitality industry: *Tourism and Hospitality Research*, 10(4), 269-285.
- [18] Bloona, R., (2007), *Coping with stress in a changing world: New York McGraw – Hill*.
- [19] Botha C & Pienaar J., (2006), South African correctional official occupational stress: the role of psychological strengths: *Journal of Criminal Justice*. 34(1): 73-84.
- [20] Bradley j. (2007) Job tenure as a moderator of stressor-strain relations: A comparison of experienced and new-start teachers, *Work and Stress*, 21(1), 48-64.
- [21] Brown, Z. A., & Uehara, D. L. (2008). Coping with teacher stress: A research synthesis for Pacific education. www.prel.org: Accessed on 5th December 2013.
- [22] Brown, Z. A., & Uehara, D. L. (2008). Coping with teacher stress: A research synthesis for Pacific education. <http://www.prel.org>
- [23] Cannon, and Walter, B., (1929) *War conflict: Double Rainbow*. Inc Data Render time: 623.
- [24] Caulfield, N., et al (2004) A reviews of occupational stress interventions in Australia: *International Journal of stress management* vol. 11 pg. 149-166.
- [25] Certo S.C. (2003), *Supervision: Concepts and skill building*, New York, NY: McGraw Hill
- [26] Chan H (2003), Hardiness and its role in the stress-burnout relationship among prospective Chinese teachers in Hong Kong, *Teaching and Teacher Education*, 19(4) , 381-395.
- [27] Chang, K., & Lu, L., (2007), Characteristics of organizational culture, stressors and wellbeing: The case of Taiwanese organizations: *Journal of Managerial Psychology*, 22, 549-568.
- [28] Chang, K., & Lu, L., (2007), Characteristics of organizational culture, stressors and wellbeing: The case of Taiwanese organizations: *Journal of Managerial Psychology*, 22, 549-568.
- [29] Chaudhry, A. Q. (2012). An Analysis of Relationship between Occupational Stress and performance. *Bulletin of Education and Research*, 13.
- [30] Cherry, N. M., et al. (2006), "Reported incidence and precipitating factors of work-related stress and mental ill-health in the United Kingdom (1996-2001)": *Occup Med (Lond)* 56(6): 414-421.
- [31] Cohen, S. and Williamson, G.M., (1991), Stress and infectious diseases in humans: *Psychology Bull* vol. 109 p 5-24.
- [32] Coleman, V., (1998) *Stress management Techniques managing for Healthy profits*. London: Cox T. 1980 stress, Maryland University park press.
- [33] Cox, T., Griffiths, A. & Rial-Gonzalez, E. (2000), *Research on Work-Related Stress*, Office for Official Publications of the European Communities: Luxembourg.
- [34] Dar L., Akmal A., Naseem A.M. and Khan K.U. (2011), Impact of stress on employee job performance in business sector of Pakistan, *Global Journal of Management and Business Research*, 11(6), 1-4

- [35] Deaconu, G., (2011), "Stress management strategies for organizations." *Psychology Review*, July.
- [36] Dua, J., (1994), "Job stress and their effects on physical Health, Emotional Health and Job Satisfaction": *Journal of Education and Administration*. Vol. 32, pg. 59-78.
- [37] Falkum, E. et al (1997), Revisiting the factor structure of the ways of coping checklist: a three-dimensional view of the problem-focused coping scale: A study among Norwegian physicians; *Personality and Individual Differences*, 22, 257-267.
- [38] Folkman, S. et al (1986), Appraisal, Coping, Health Status, & Psychological Symptoms, *Journal of Personality and Social Psychology*, 50, 571-579.
- [39] Friedman, M., and Roseman, R., (1974), "Type A Behaviour and Your Heart." Greenwich: Fawcett publications.
- [40] Giga, S., (2011), The Implied Employment Relationship: Investigating the effects of psychological contract violations on Employee Wellbeing: Doctoral Thesis University of Manchester Institute of science and Technology, Manchester.
- [41] Glenn, D. I., (2012), "Determining Sample Size, PEOD6." University of Florida; IFAS Extension: Obtained from <http://edis.ifas.ufl.edu>.
- [42] Greenberg, J., and Baron, R., (2007) "Behaviour in organizations." New York: Prentice Hall.
- [43] Guglielmi, R., & Tatrow, K. (1998), Occupational stress, burnout, and health in teachers: A methodological and theoretical analysis. *Review of Educational Research*, 68(1), 61-99.
- [44] Hackman, J. R., & Oldham, G. R. (1980). *Work Redesign*, Reading, MA: Addison-Wesley.
- [45] HavLovic, J. & Keenan, P., (1991), "Coping with stress: The influence of Individual Characteristics"; *Journal of Social Behaviour*. Vol. 6, pg. 25-51.
- [46] He, N. et al (2005), Do race and gender matter in police stress: A preliminary assessment of the interactive effects: *Journal of Criminal Justice*. 33(6): 533-47.
- [47] IvaneRich, J. et al (2006), "Organization Behaviour and Management": New York; Mc. Graw Hill.
- [48] Jayashree, N., (2008), "Factors influencing stress and coping strategies among the Degree College Teachers of Dharwad City, Karnataka": Unpublished Msc thesis, University of Agricultural Sciences, Dharwad.
- [49] John, J., (2009), Hedrich Centre for workforce Development, "Work and Family Pressures Undercutting": *Journal of Technology and Education in Nigeria*. Vol. 12(2) pg. 9-18.
- [50] Judge Sharon, (2003), "Determinants of parental stress in Families Adopting Children from Eastern Europe": *National council on Family Relations*. Vol. 52 (3) pg. 241-248.
- [51] Kaplan, H.G., et al (2004), "Efficacy and Safety of different doses": *Journal of Cannabis Therapeutics* (2001-2004).
- [52] Karasek, R., et al., (1981), "Job decision latitude, job demands and cardiovascular disease: a prospective study of Swedish men": *American journal of public health*, (71) pg. 694-705.
- [53] Karatepe, O.M. et al (2012), Affectivity and organizational politics as antecedents of burnout among frontline hotel employees: *International Journal of Hospitality Management*, 31(1), 66-75.
- [54] Khanka, S.S., (2007) "Corporate Behaviour." New Delhi, Chand and company Limited.
- [55] Kolt G. (2003), Eustress, distress, and interpretation in occupational stress, *Journal of Managerial Psychology*, 18(7), 726-744
- [56] Kompier, M., (2003), Job Design and Well-being: In M. Schabracq, J. Winnubst & C.L. Cooper, (Eds.), *Handbook of Work and Health Psychology*, 429-454.
- [57] Konirigield, et al (2004), "Work Related Stress": European Foundation for Improvement. www.eurofound.europa.eu/.../TN0502TRO1/TNO502TR.
- [58] Kreitner, R., Kinicki, A., (2007), "Organizational Behaviour:" Mc. Graw Hill.
- [59] Kumar, I. A. (2013), Occupational Stress among Male and Female Elementary School Teachers of District Pulwama: *International Journal of Scientific & Engineering Research*, 940.
- [60] Kumar, R., (2005) *Research Methodology-A Step-by-Step Guide for Beginners*, Pearson Education. 2nd. ed, Singapore.
- [61] Landa, J. M.A. et al (2008), The relationship between emotional intelligence, occupational stress and health nurses: a questionnaire survey; *International Journal of Nursing Studies*. 45(6): 888-901.
- [62] Larson, L. L. (2004). Internal auditors and job stress. *Managerial Auditing Journal*, 19, 1119-1130.
- [63] Larson, L. L. (2004). Internal auditors and job stress. *Managerial Auditing Journal*, 19, 1119-1130.
- [64] Larson, L. L. (2004). Internal auditors and job stress. *Managerial Auditing Journal*, 19, 1119-1130.
- [65] Le Favre M., Matheny J. and Kolt G. (2003), Eustress, distress, and interpretation in occupational stress, *Journal of Managerial Psychology*, 18(7), 726-744
- [66] Le Favre M., Matheny J. and Kolt G. (2003), Eustress, distress, and interpretation in occupational stress, *Journal of Managerial Psychology*, 18(7), 726-744
- [67] Lee, David, (2009) *Managing Employee Stress and Safety*, Brochure: Author Memic.
- [68] Lind, S.L., and Otte, F.L., (1994) Management styles mediating variables and stress among HRD professionals, *Human Resource Development*. Winter: pg. 301.
- [69] Lu CQ, et al (2005), Managers' occupational stress in China: the role of self-efficacy: *Personality and Individual Differences*. 38(3):569-78.
- [70] Luthan, F., (2008), *Organizational Behaviour*: New York: Mc. Graw Hill.
- [71] Mairura, L., (2009), "counselling for Teenagers with chronic stress: A case of students in Nairobi Day Schools." Nairobi, Kenya
- [72] Margets, E.L., (1975), "Stress, Homeostasis and the Human Ecological continuum": *Journal of Society, Stress and Distress*. vol. 2. Pg. 22-36.
- [73] Mark, G.M. & Smith, A. P. (2008), The relationship between workplace stress and job characteristics, individual differences, and mental health.
- [74] Mc. Gart, J., (1976), *Social and Psychological Factors in Stress*. New York: Holt and Rinchart.
- [75] Mc. Hugh, M., (1997) "The stress factor: another Item for change management Agenda." *Journal of Organizational change* vol. 10 pg. 345-362.
- [76] Mc. Shane, S., Von. Glinow, and Sharma, R., (2008) *Organizational behaviour*. New Delhi: Mc. Graw.
- [77] Miller, L., (2009) *Stress Causes Rigidity (PhD)*. The Business case for stress management – 4 imprint. Info.4imprint.com/.../uploads/M0709-02 blue-papers.
- [78] Mohammadi Z. et al. (2013), Evaluation of relationship occupational stress with shift work in the agency drivers in Yazd: *Occupational Medicine*, Vol. 6, No. 3
- [79] Mohanraj, P. & Manivannan, L., (2013), Occupational stress among migrated workers in unorganised sectors : IRACST- International Journal of Research in Management & Technology (IJRMT). Vol. 3, No.1.
- [80] Mojoyinola, J. K. (2008), Effects of Job Stress on Health, Personal and Work Behaviour of Nurses in Public Hospitals in Ibadan Metropolis, Nigeria: *Journal of Social Work*, 143-148.
- [81] Munal, J., (2005), "Stress and Individual Performance of workers in Hotels at the Kenyan coast": Unpublished M.A. thesis, Cornell University USA.
- [82] Musyoka, M. et al (2012), Employee stress and performance of companies listed in the Nairobi securities exchange: *DBA Africa Management Review* 2012, vol.3. No. 1 pp 115-129.
- [83] Naituli, B.K., (2008), "Leadership practices and the influence of stress: A study of Kenyan managers": Unpublished thesis, Egerton University.
- [84] Nakata, A., M. Takahashi, et al. (2008). "Perceived psychosocial job stress and sleep bruxism among male and female workers." *Community Dent Oral Epidemiol* 36(3): 201-209
- [85] National Occupational Health and Safety Commission (2003), 'Compendium of workers' compensation statistics, Australia, 2000-2001: Canberra, Australia. NEL MH, (2004)
- [86] New Stroom, J., (2007) *organization behaviour: human behaviour at work*. New Delhi: Mc. Graw Hill.
- [87] Ng'ethe, J.M. (2012), Determinants of Academic Staff Retention in Public Universities in Kenya: Empirical Review. *International Journal of Humanities and Social Science* Vol. 2 No. 13

- [88] Ngeno, G., (2007) "Causes of Burnout among primary school Teachers within Kericho municipality, Kenya."
- [89] Ngome, C.K. (2010) Massive Growth of University Education in East Africa and the Challenges facing the Sector from 2000 to 2011: The case of Kenya, IUCEA conference, 19th-21st October, 2010, Kampala, Uganda.
- [90] Nilufar, et al (2009) International conference on Business and Economic Research, Academic report has been reported all over the world.
- [91] NIMH (2013), Stress for Adults: How it affects your health and what you can do about it. Available at: http://www.nimh.nih.gov/health/publications/stress/Stress_Factsheet_LN_142898.pdf
- [92] Noblet, A., (2003) "Building Health promoting work settings: Identifying the relationship between work characteristics and occupational stress in Australia" Health Promotion International. Vol.18 (4) pg.351-359.
- [93] Obwogi, J. (2011), Factors that affect Quality of Teaching Staff in Universities in Kenya. PhD Thesis, Jomo Kenyatta University of Agriculture and Technology
- [94] Olali, B., (2005), "Stress and Individual Performance: A case of Kaimosi Teachers College" Unpublished M.A.; Thesis Moi University, Kenya.
- [95] Owino, G. et al (2011), Role of institutional managers in quality assurance: reflections on Kenya's University education: Australian Journal of Business and Management Research. Vol.1 No.2
- [96] Pabla, D. M. (2012), Occupational Stress Amongst Teachers of Professional Colleges in Punjab: Indian Journal of Research, 112.
- [97] Park, C.L. & Folkman, S. (1997), Meaning in the context of stress and coping, Review of General Psychology, 2, 115-144.
- [98] Park, C.L. & Folkman, S. (1997), Meaning in the context of stress and coping, Review of General Psychology, 2, 115-144.
- [99] Perrewe, P.L., & Zellars, K.L. (1999), An examination of attributions and emotions in the transactional approach to the organizational stress process: Journal of Organizational Behaviour, 20, 739-752.
- [100] Pestonjee, D.M., (1992), Stress and Coping. Sage publications New Delhi.
- [101] Pierce J., & Delahaye, B., (1996), Human Resource management implications of dual-career couples. International Journal of Human Resource management (v7) pg. 905-923.
- [102] Porter, and Steers, (1987), Effects on role loss on work-related attitudes. Journal of Applied Psychology vol. 72(2) pg. 287-293.
- [103] Ramzan, M., (2012), A Study on Understanding the Factors Contributing To Teachers' Professional Stress in the Private Schools of Gilgit-Baltistan. Strength for Today and Bright Hope for Tomorrow, 349
- [104] Repeth, R.L (1993), "The effect of workload and Social Environment on Health" L. Goldberger and S. Breznitz (Ed). Handbook of stress: Theoretical and Clinical Aspects. pp 120-130
- [105] Robbins S. et al (2009), Organization and stress management: New Delhi, India; Dorling Kindersley
- [106] Robbins, and Judge, (2007), Organizational behaviour: New Jersey; Pearson Education.
- [107] Robbins, S., (2003), Organizational behaviour: New Jersey; Pearson Education. Rutgers University.
- [108] Robert, J. C., (2002) Types of Research Design: Analyzing, Interpreting & Using Educational Research. Resources for the Ed. D. unit, Research Methods, 2002 found at www.dur.ac.uk/r.j.coe/resmeths/types.doc.
- [109] Rosania, A. E., K. G. Low, et al. (2009). "Stress, depression, cortisol, and periodontal disease": J Periodontol 80(2): 260-266.
- [110] Santos, J. R. A., (1999) Cronbach Alpha: A Tool for Assessing the Reliability of Scales. Available at <http://www.joe.org/joe/1999april/tt3.html>.
- [111] Sayeed, O.M., (2001), organizational commitment and conflict. New Delhi: Sage publication.
- [112] Selye, H., (1956) Stress of Life. McGraw Hill: New York.
- [113] Spector, P.E., (2002), "Employee Control and Occupational Stress": Sage publications, vol.11 (4) pg. 133-136.
- [114] Sultana, B. (2012), The Nature and Impact of Teacher Stress in the Private Schools of Gilgit-Baltistan, Pakistan: International Journal of Academic Research in Progressive Education and Development, 82, 83.
- [115] Sveinsdottir, H., et al (2006). Occupational stress, job satisfaction, and working environment among Icelandic nurses: a cross-sectional questionnaire survey: International Journal of Nursing Studies. 43(7): 875-89.
- [116] Tetley, J.W. (2009), Deficits in Academic Staff Capacity in Africa and Challenges of Developing and retaining the next Generation Academics: Partnership for Higher Education in Africa.
- [117] Trice, H.M. & Sonnenstuhl, W.J., (2010), "The construction of drinking norms in work organizations": Journal of studies on Alcohol vol. 51, pg. 201-220.
- [118] Vakola, M., & Nikolaou, I. (2005), Attitudes towards organizational change: What is the role of employees' stress and commitment? Employee Relations, 27, 160-174.
- [119] Vitaliano, P.P. et al (1985), The Ways of Coping Checklist Psychometric Properties, Multivariate Behavioural Research, 20, 3-26.
- [120] Warr, P., (1990), The Measurement of Well-being and Other Aspects of Mental Health.: Journal of occupational psychology. (v.52) pg. 129-148.
- [121] Waswa F. & Swaleh S. (2012), Faculty opinions on emerging corporatization in public Universities in Kenya. Education and General Studies Vol. 1(1) pp. 009-015
- [122] Webster, T., & Bergman, B., (2009), Two international conferences on management 969 (21CM 2012): Occupational stress: counts and rates compensation and working conditions. Washington, USA.
- [123] Welford, A., (1973), "Stress and performance": Ergonomics, vol. 16 pg.567.
- [124] West, H., & Mackay, J., (1999), "Employment Roles and Counsellors in Employee Assistance Programmes": Journal of counselling psychology. Vol.7 pg. 355-389.
- [125] White E. (2006), Opportunity knocks and it pays a lot better, The Wall Street Journal, 13
- [126] Wilson, B., (2007) Wilson Heart care, Heart Math and Cardiologist...publications in January 2007(PhD). www.wilsonheartcare.com/bio/2.html
- [127] Workplace Relations Ministers' Council (2003) Comparative performance monitoring, fifth report, Australia and New Zealand Occupational Health and Safety and workers' compensation schemes, Canberra.
- [128] Worrall, L., & Cooper, C., (1999), Quality of working life survey: Institute of Management, London.
- [129] Yagil, D., (1998). If anything can go wrong, it will: occupational stress among inexperienced teachers: International journal of stress management. (v5) pg. 179-188.
- [130] Yamane, Y., (1976) Statistics: An introductory Analysis, 2nd Ed. New York: Harper and Row.
- [131] Yambo, J.M.O. et al (2012), Investigating High Schools Principals Stress in Relation to their job experience in schools in Southern Nyanza Region of Kenya: International Journal of Academic Research in Progressive Education and Development, vol. 1, No. 4 ISSN 2226-6348.
- [132] Zhimin, L. & Ramani K., (2012), A study on the conflict resolution mechanisms in higher educational institutions: A case of Kenya's public universities. Educational Research Journals Vol. 2(6), pp. 208-216.

AUTHORS

First Author – John Ng'ang'a Karihe, Doctor of philosophy in Human Resources Management of Jomo Kenyatta University of Agriculture and Technology

Second Author – Professor G. S. Namusonge, Supervisor, Jomo Kenyatta University of Agriculture and Technology

Third Author – Dr. Mike Iravo, Supervisor, Jomo Kenyatta University of Agriculture and Technology

APPENDIX 3: TABLES
Table 4.26: Correlations for Employee Performance

	Statistic	g1	g2	g3	g4	g5	g6	g7	g8	g9	g10	g11	g12	g13
g1	Pearson Correlation	1	.009	.012	-.080	.069	.033	-.067	-.019	-.011	-.060	-.037	-.033	-.098
	Sig. (2-tailed)		.871	.833	.153	.205	.544	.217	.726	.845	.273	.498	.541	.075
g2	Pearson Correlation	.009	1	-.025	-.070	.110	.176**	.286**	.141*	-.188**	.265**	-.147**	-.074	.139*
	Sig. (2-tailed)	.871		.658	.229	.053	.002	.000	.013	.001	.000	.009	.197	.016
g3	Pearson Correlation	.012	-.025	1	.104	-.037	-.025	.030	-.016	.028	-.008	-.075	-.059	-.006
	Sig. (2-tailed)	.833	.658		.064	.502	.645	.582	.776	.618	.881	.172	.284	.920
g4	Pearson Correlation	-.080	-.070	.104	1	.076	-.113*	.248**	.040	.261**	.309**	-.261**	-.121*	-.061
	Sig. (2-tailed)	.153	.229	.064		.169	.041	.000	.473	.000	.000	.000	.028	.278
g5	Pearson Correlation	.069	.110	-.037	.076	1	.022	-.121*	.015	-.157**	.136*	.151**	.277**	-.063
	Sig. (2-tailed)	.205	.053	.502	.169		.682	.025	.778	.004	.011	.005	.000	.249
g6	Pearson Correlation	.033	.176**	-.025	-.113*	.022	1	-.155**	.117*	.081	.068	-.273**	-.358**	-.209**
	Sig. (2-tailed)	.544	.002	.645	.041	.682		.004	.030	.134	.212	.000	.000	.000
g7	Pearson Correlation	-.067	.286**	.030	.248**	-.121*	-.155**	1	.162**	.211**	.462**	-.214**	-.140**	.228**
	Sig. (2-tailed)	.217	.000	.582	.000	.025	.004		.003	.000	.000	.000	.009	.000
g8	Pearson Correlation	-.019	.141*	-.016	.040	.015	.117*	.162**	1	.118*	.312**	.022	-.005	.237**
	Sig. (2-tailed)	.726	.013	.776	.473	.778	.030	.003		.028	.000	.688	.933	.000
g9	Pearson Correlation	-.011	-.188**	.028	.261**	-.157**	.081	.211**	.118*	1	.176**	-.070	-.026	-.048
	Sig. (2-tailed)	.845	.001	.618	.000	.004	.134	.000	.028		.001	.194	.637	.382
g10	Pearson Correlation	-.060	.265**	-.008	.309**	.136*	.068	.462**	.312**	.176**	1	.101	.107*	.345**
	Sig. (2-tailed)	.273	.000	.881	.000	.011	.212	.000	.000	.001		.061	.049	.000
g11	Pearson Correlation	-.037	-.147**	-.075	-.261**	.151**	-.273**	-.214**	.022	-.070	.101	1	.693**	.192**
	Sig. (2-tailed)	.498	.009	.172	.000	.005	.000	.000	.688	.194	.061		.000	.000
g12	Pearson Correlation	-.033	-.074	-.059	-.121*	.277**	-.358**	-.140**	-.005	-.026	.107*	.693**	1	.218**
	Sig. (2-tailed)	.541	.197	.284	.028	.000	.000	.009	.933	.637	.049	.000		.000
g13	Pearson Correlation	-.098	.139*	-.006	-.061	-.063	-.209**	.228**	.237**	-.048	.345**	.192**	.218**	1
	Sig. (2-tailed)													

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Effects of Work Relationships' Stress Factors on the Performance of Employees in Public Universities in Kenya

John Ng'ang'a Karihe¹, Professor G. S. Namusonge², Dr. Mike Iravo³

¹Doctor of philosophy in Human Resources Management of Jomo Kenyatta University of Agriculture and Technology

²Supervisor, Jomo Kenyatta University of Agriculture and Technology

³Supervisor, Jomo Kenyatta University of Agriculture and Technology

Abstract- The aim of this study was to assess the effects of occupational stress and how it affects employee performance in the public universities in Kenya. Specifically the study seeks to identify the influence of workplace relationship stress factors on the performance of employees in public universities in Kenya. This used both qualitative and quantitative methods in the selection of the participants and collection of data. Cluster sampling was employed to select 384 respondents. Data collection instruments included interviews, questionnaires and document reviews. The collected data was captured in MS Excel and analyzed using SPSS version 24 (Statistical Package for Social Scientists). Linear regression analysis and Pearson's correlation coefficient were run to determine relationship between stress factors and workers performance. The analyzed data was presented in suitable graphs, charts and tables. By correlating the determinants of stress with performance, the study found out that the determinants of stress include movement, motivation, workers relationships, management and working facilities. The study found a significant relationship ($F(3,342) = 57.717, p < 0.05$) between Worker's relationship, Worker's movement, Workplace facilities, Motivation and Management and employee performance. The nature of the relationship was found to be positive in the sense that unit increase in Worker's relationship and Management leads to an increase in Employee performance as demonstrated by the equation: $\text{Employee performance} = 2.286 + .126 \text{ Worker's relationship} + .096 \text{ Management}$

Index Terms- stress factors, employee performance, worker relationships

I. INTRODUCTION

Stress at workplace is certainly not a new concept; history indicates that stress was experienced even with our cave-dwelling ancestors. Khanka (2007) postulates that our cave-dwelling ancestors faced stress every time they left their caves and encounter their enemy, the saber toothed tigers. He argues that the tigers of yesterday are gone but they have been replaced by other predators of modern times such as work load, time deadlines, downsizing, mergers, poorly designed jobs, marital disharmony, financial crises and traffic jams. Most employees are reporting increased levels of stress and the recent working environment is making things worse (Luthans, 2008).

Globalisation has left institutions and organisations facing stiff competition and led to aggressive cost cutting. Information technology has accelerated the speed at which business transactions can be performed and put pressure on the workforce to be even more productive. These pressures on organisations have put workers under a lot of stress (Newstrom, 2007). Due to the competitive nature of the job environment most of the people in the world are spending their time for job related work purposes, ignoring the stressors that are influencing their work and life. Usually people are more worried about the outcome of their work and that can even affect the way they treat other people and how they communicate with their peers and customers. Nilufar et al. (2009) posits that people with a higher percentage of occupational stress may not be satisfied with their job and therefore they will not feel happy working in the organization.

Recent trends have also made it increasingly difficult for employees to adequately balance the responsibility of their families, as employee are working longer hours and bringing more work home at night. This has resulted to more pressure being placed on the work-family relationship such that coordination of work, vocation schedules and child care options have become very unsuccessful (Dar et al. 2011). More and more voices warn about the possible risks that could emerge if the human resource management ignores the current signs of increase in levels of stress among employees (Robbins & Judge, 2007). Organisations therefore need to respond to stress experienced by employees in order to enhance their legitimacy and obtain the resources necessary for their survival.

Stress in University workers is an on-going issue of concern for those involved in education. Numerous studies found that job stress influences the employees' job satisfaction and their overall performance in their work, because most of the organizations now are more demanding for the better job outcomes (McGrath et al., 2003). Academic staff has a major role to play in achieving the objectives of the institution (Kumar, 2013). The performance of the staff; teaching, non-teaching teachers and also as managers, determines to a large extent, the quality of the student experience in the Universities and has a significant impact on student learning and thereby on the contribution that such institutions can make to the society (Kumar, 2013). Stress of University workers therefore needs to be addressed.

Mojoyinola (2008) contend that coping can function to change the situation out of which stressful experiences originate (Problem-focused), change the meaning of such experiences

before the emergence of stress (perception-focused), and control the emotional reaction to stress after it has emerged (emotion-focused). If one is suffering from stress, the aspect of life that causes it has to be identified. These aspects will then help in developing strategies to deal with stress. According to Dar, Akmal, Naseem and Khan (2011) steps such as changes in lifestyle or other small strategies can help to deal with stress. The work can be delegated or shared and avoid confrontation with problematic colleagues. Learning to be assertive, taking regular exercise, avoiding alcohol and drugs can reduce stress. On the other hand, eating a healthy, balanced diet rich in fruits and vegetables, finding humour in stressful situations, time management, talking to friends or family and sharing thoughts and fears can fight stress.

Workers in the Universities have often found themselves in dissatisfactions that have manifested them greatly in the recent past. In November 2011, a major strike was held nationwide in Kenya by all the public universities workers. This led to the closure of several universities. This strike among other things affected learning, examinations and graduation programmes. Concurrently there was a go slow in Brazil in October and November by dissatisfied university lecturers. It is with this background that the researcher seeks to carry out a study in selected universities in Kenya to establish the effects of occupational stress on employees' performance and provide practical coping strategies that can be employed to reduce or completely alleviate stress in public universities.

Stress not only leads to poor performance that is detrimental to the economy, but also leads to poor health. The National Institute of Mental Health (NIMH) estimates that depression has resulted in 23 billion dollars loss a year in lost work days and 60 to 90 per cent of doctor visits are attributed to stress-related illness and symptoms (NIMH, 2013). When employees get sick, the sick offs increase. This leaves behind undone jobs or even skipped responsibilities. The sickness also affects the members of the employee's family both financially and emotionally. This cycle continues if no intervention comes forth, leading to even higher stress levels and eventually depression, which may lead to development of chronic and costly diseases such as heart diseases, diabetes and cancer, which can collectively account for a vast amount of all health care costs. Diabetes alone costed businesses 58 billion dollars in 2007 (Barling et al., 2004).

If this situation continues, especially among workers in the public universities who are expected to nature future human resources for purposes of developing the economy, universities are bound to be cash trapped with workers medical expenses, students will get poor education and universities will be prone to frequent strikes of dissatisfied and stressed workers (Munali, 2005). According to Waswa and Swaleh (2012) minimal attention has been given towards ensuring workers in public universities have been provided with the necessary resources, motivation, effective job allocation measures and management to avert continuous strikes that have lowered the standards of education in the country. Additionally Owino et al (2013) argues that lack of resources, motivation, poor leadership and negative relationships leads to stressed employees and poor performance. Zhimin and Ramani (2012) advises that stress factors should be met to enhance conflict resolution within Kenya's public universities. This study therefore seeks to assess the determinants

of occupational stress in public universities and their contribution to the performance of workers.

The information from this study may form part of policy making for both the government and the management of public universities. The information on the stress factors affecting the performance of workers in public universities may be used by the management of the public universities in developing strategies and providing an environment that will ensure improved productivity of the workers.

Through this study on the stress factors affecting the performance of workers in public universities, the general public and the management of the universities as well as the workers themselves will be able to understand and appreciate the performance of workers that are exposed to such stressors.

Academicians and researchers who are willing to provide more education and solution to workers stress may use the information from this study to inform their understanding and arguments. Additionally, the information from the study may also form basis for literature for other researchers and academicians who are willing to carry out studies in the same field in sub-Saharan Africa.

The study was carried out within Nairobi County metropolitan. The study therefore focused on public universities that operate within or closer to Nairobi County. Nairobi Metropolitan consists of four regions which cover approximately 32000 square kilometres the four regions are: Core Metro that includes the City of Nairobi; Northern Metro includes the municipal councils of Kiambu, Limuru, Ruiru, Thika, and Karuri, the Town councils of Kikuyu and the County Council of Kiambu; Southern Metro that includes the Town Council of Kajjado and the County Council of Olkejuado; and Eastern Metro that includes the Town Council of Kangundo/ Tala, the Municipal Councils of Machakos and Mavoko and the County of Masaku.

Public universities were selected because their workers have unions or organisations that advocate for a stress free environment for them. The unions (Kenya Universities Staff Union (KUSU) and the Universities Academic Staff Union (UASU)) are responsible for ensuring that there are favourable working conditions for all public university workers. Involving the public universities therefore provided in-depth information on workers stress on performance since they are aware of their stressors at work and are taking steps to address them by forming unions to champion for their rights. Nairobi Metropolitan was chosen as the area of study because all the major public universities in Kenya are either based or have campuses within Nairobi Metropolitan.

II. LITERATURE REVIEW

Literature review is a body of text that aims to review the critical points of current knowledge including substantive findings as well as theoretical and methodological concepts to a particular topic. In this research, we are investigating the effects of occupational stress on the employees and how it affects performance in public universities in Kenya. In this chapter the researcher discussed various theoretical models on stress, conceptual framework, review independent and dependent variables, empirical studies on existing literature on stress and

performance, critique of the existing literature relevant to the study, research gap and the summary.

2.1 Theoretical framework

2.1.1 Relational theory

In his theory, Lazarus regards stress as a relational concept, that is, stress is not defined as a specific kind of external stimulation or a specific pattern of physiological, behavioural, or a subjective reactions. Instead, stress is reviewed as a relationship between individuals and their environment. Psychological stress involves relationship with the environment that an individual appraises as significant for his or her well-being and in which the demands tax or exceed available coping resources. These definitions points to two processes as central mediators within the person-environment transaction: cognitive appraisal and coping.

This concept is based on the idea that emotional processes (including stress) are dependent on actual expectancies that persons manifest with regard to the significance and outcome of a specific encounter. This concept is necessary to explain individual differences in quality, intensity, and duration of an elicited emotion in environments that are objectively equal for different individuals. The most important factors on the personal side are motivational dispositions, goals, values and generalized expectancies. Relevant situational parameters are predictability, controllability, and imminence of a potentially stressful event.

2.1.2 Homeostasis theory

According to Mojinyinola (2008), the body possesses internal mechanism to maintain a stable bodily functioning or equilibrium. As the environment presents the organism with various challenges, the body must respond to each new situation and by adjusting various physiological systems to compensate for the resources being taxed. A classic example of this type of compensation involves fluid regulation. When an organism ingests a large amount of water, the kidney releases more waste fluid into the bladder for eventual disposal in an effort to maintain bodily equilibrium. Many of the feedback mechanisms that regulate blood pressure presented in the body share similar characteristics with bodily systems that maintain homeostasis. According to Mojinyinola (2008), failure of the body to respond to environmental challenges by maintaining bodily homeostasis results in damage to target organs and eventually death. The concept of homeostasis introduced therefore proves to be very valuable in explaining how acute physiological stress responses to threats of survival would lead toward chronic stress responses.

2.1.3 Welford's performance and demand theory

Welford's performance and demand theory (1973) shares much in common with the theory proposed by Selye (1956). In this theory, stress arises whenever there is a departure from optimum conditions of demand which the person is unable to correct. Organisms including man appear to have evolved so that they function best under conditions of moderate demand. An individual's performance is less than maximum efficiency if they experience either too high or too low level of demand. Margetts (1975) offers a similar approach in terms of stimulus input. Living organisms adjust themselves to maintain a reasonable input of stimuli. If the input of stimuli is excessive or insufficient for the individual organism, the excess or insufficiency can be considered stressful. The organism's homeostasis is threatened by stress, and if it cannot manage it, it goes into a state of

disequilibrium or breakdown. This may be temporary, pending readjustment, or may proceed to a more profound disorder, leading to functional or structural pathology. This theory is credited for using the inverted U when explaining the relationship between demand and performance, which has some biological validity (Nakata et al., 2008). Bloona (2007) argues that just like the response based theory, the Welford performance and demand theory leaves out individual characteristics which explain why people perform differently under the same stressor. Cox and Mackay (1976) proposed a more complex theory, which grew out of the need to systematically understand the transaction between the individual and his environment. The primary focus of this theory is on individual perceptual phenomena rooted in psychological process. They explain the role of cognitive appraisal of potentially stressful situation in determining how one will react. If a situation demands too much of a person but he has not realized his limitation, he will work on without being stressed until it becomes obvious to him that he cannot cope, he then experiences stress. McGrath (1976) further observes that stress arises when there is an imbalance between perceived demand and the perception of his capability to meet the demand. The presence of this perceptual factor allows for operations of a wide variety of organismic variables such as personality which contributes to the existence of individual characteristics. This theory is credited for introducing the individual variation aspect. Since it considers the status of the individual in relation to his environment and also brings in the individual characteristics which are often forgotten in laboratory studies. Critics of this theory argue that it does not account for situations that place psychological demands without the immediate involvement of other more physiological processes (Cox 1980).

2.1.4 Stress Theory Model

A model is a systematic organization of knowledge on some topic. There are several models developed to provide an insight on stressors and their coping strategies. This study will however major on only two models to explain stressors and one model focusing on stressors and their coping strategies.

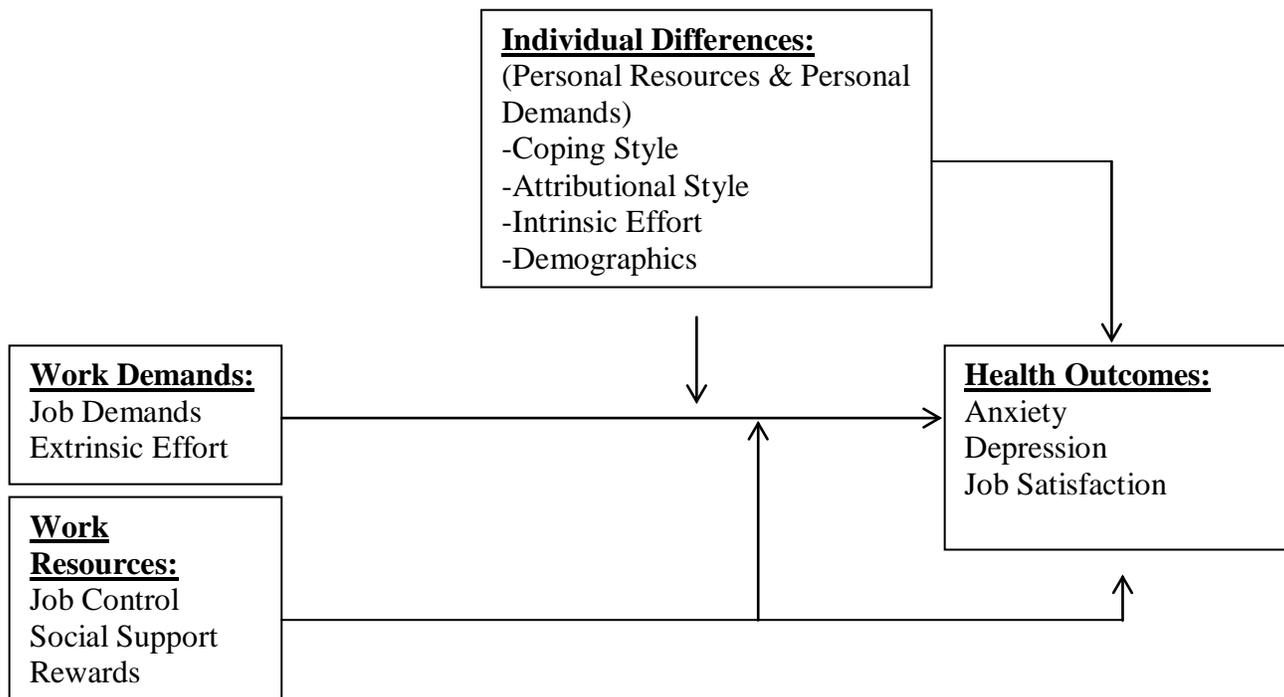
a) Demands, Resources, and Individual Effects model

In light with the literature on stress models, Mark and Smith (2008) suggested the DRIVE model that perhaps elucidates stressors effectively. In this model they acknowledge the important role played by psychosocial workplace stressors in the stress process, and tries to account for the role of important individual difference factors in the development of subjective experiences of stress, and in influencing the possible health-related outcomes that result from subjective stressful perceptions. This framework aims to represent key aspects of the stress process, without getting bogged down in the minutiae of more complex theories and mental processes.

They developed and tested the model shown below which simultaneously compared a number of job characteristics and individual difference variables in the prediction of anxiety, depression, and job satisfaction, in a working population. Independent variables included: job demands, social support, decision authority, and skill discretion; extrinsic effort, intrinsic effort and rewards; 40 coping behaviours which included the categories of problem focused coping, seeking advice, self blame, wishful thinking, and escape/avoidance; attributional/explanatory styles; and age, gender, and

demographic variables. This framework was called the Demands, Resources, and Individual Effects model (DRIVE). Source: Mark and Smith (2008)

Figure 2.1 The DRIVE model



In the model, workplace and individual characteristics are conceived of in terms of work demands and resources, and individual demands and resources. Other work demands and resources could include workload, bullying, job security, management style, feedback etc, and other personal demands and resources could include self efficacy, locus of control, personality, home environment, experience, work/life balance, role conflict, etc.

The model proposes that work demands, individual differences, and work resources are all proposed to have main effect relationships on anxiety, depression, and job satisfaction (other outcomes could include organizational commitment, musculoskeletal disorders, gastro-intestinal disorders, heart disease, absence). It is also proposed that work resources and individual differences may moderate the relationship between work demands and health outcomes. The individual difference variables of positive coping (problem focused coping) and attributional styles can be seen as personal resources, and intrinsic effort, negative coping (self-blame) and attributions as “personal demands”, as maladaptive behaviours are effectively self-induced demands. This model makes no predictions about the “importance” of the different variables in predicting outcomes, and gives each type of variable (work and individual demands and resources) a theoretical equivalency.

b) The cognitive theory of psychological Stress and coping

Lazarus and Folkman’s theory of psychological stress and coping (1980) is perhaps the most theoretically influential transactional theory. Sometimes known as the Cognitive-Relational approach, the individual and their environment are

seen as coexisting in a dynamic relationship, where stress is the psychological and emotional state that is internally represented as part of a stressful transaction (Folkman, Lazarus, Gruen&DeLongis, 1986).

The two key concepts in this process are appraisal and coping (Cox et al., 2000).Folkman et al (1986) describe primary appraisal as the first stage of the appraisal process, where encounters are subjectively evaluated to see what is at stake in terms of potential risk (Perrewe&Zellars, 1999) and these assessments allow for the influence of individual differences, because the nature of what is considered stressful is individual-specific (Park &Folkman, 1997).

In later work, Park and Folkman (1997) write that the attribution of meaning that individuals give to events, can be framed by existing beliefs based on their global meaning. These are enduring beliefs and valued goals, based on fundamental assumptions, theories of reality (e.g. religion), self-worth, life experience etc. Park and Folkman (1997) propose that the making of situational meaning is what occurs when an individual’s global beliefs and goals interact with the specifics of a particular person-environment transaction which are defined by the processes of appraisal and coping.

If a situation is evaluated as potentially stressful, then secondary appraisal occurs, which is where the individual evaluates if the potential harm can be altered, avoided or prevented (Park &Folkman, 1997), where to assign blame or credit, and what future expectations are. Potential actions or ways of coping are assessed, informed by past coping experience, personality, personal resources (and presumably global meaning). Folkman and Lazarus (1980) described many types of coping behaviours, and suggested that they could be

aggregated into two major categories of coping response: problem-focused coping (attempts to cope using more rational problem solving type approaches) or emotion-focused coping (emotional-oriented coping approaches) each of which are suitable in different kinds of situation.

While the problem focused/emotion focused distinction has been popular in research, many argue that it is important to split coping into more distinct categories (many based on Folkman and Lazarus' work) such as problem focused coping, seeking social support, blamed self, wishful thinking, and avoidance (Vitaliano, Russo, Carr, Maiuro & Becker, 1985) and action oriented coping, accommodation, positive thinking, seeking support, self-blame and defence (Falkum, Olff & Aasland, 1997). Once possible coping methods are assessed and selected, then the final stage of the model occurs, where coping is implemented. Coping has been characterized as (Folkman et al, 1986) "cognitive and behavioural efforts to manage (reduce, minimise, master, or tolerate) the internal and external demands of the person-environment transaction that is appraised as taxing or exceeding the person's resources". Robbins, Judge and Sanghi (2009), suggest that coping is the main method by which incongruence between global meaning and situational meaning is managed. A failure to cope successfully (from excessive demands or lack of resources) is likely to lead to stress and negative health and organizational outcomes (Chaudhry, 2012).

2.2 Empirical Studies carried on causes and effects of Stress

The literature indicates that there is a relationship between age, gender, marital status, educational level, position, length of service and working experience with occupational stress (Landa et al. 2008; Lu, Siu & Cooper, 2005) but the results of a study that was conducted on urban police officers in the USA, showed that dynamic factors such as work environment and coping mechanisms, contributed more to explain variance of police stress than static factors such as race and gender (He, Zhao & Ren, 2005). In several studies income, heavy workload, lack of workspace, lack of resources (including equipment and material to do tasks), absence of proper company procedures, insufficient time to perform duties, meeting deadlines imposed by others, have been introduced as stressors related to work environment (Botha & Pienaar, 2006). In other studies external accountability, responsibility, work relationships, insufficient consultation, communication, inadequate feedback on performance and organizational changes have been introduced as sources of occupational stress (Sveinsdottir, Biering & Alfons, 2006).

According to Beehr, (2005) work overloads and time constraints were significant contributors to work stress among community nurses. Workload stress can be defined as reluctance to come to work and a feeling of constant pressure (i.e. no effort is enough) accompanied by the general physiological, psychological, and behavioural stress symptoms (Larson, 2004). Al-Aameri (2003) has mentioned in his studies that one of the six causes of occupational stress is pressure originating from workload. Alexandros-Stamatios, et al. (2003) also argued that "factors intrinsic to the job" means workload, variety of tasks and rates of pay.

Grzywacz (2004) conducted a research on stress and education level among 1031 workers. He found out that less educated people suffer few stressful days but when they suffer stress it's more severe and had a large impact on their health.

Combs (2004) on the other hand, conducted a research on marital status and stress among 300 workers and found that married couples reported more stress than their single counter parts.

Karatepe et al (2012) conducted a research on role stress, emotional exhaustion and turnover on frontline hotel employees in Cyprus. The results showed that the positive effect of role conflict and emotional exhaustion on turnover intentions was weaker among the frontline employees with longer tenure. Cavanaugh et al (2010) also conducted a research on role conflict and personality among managers. They found that individuals with type B personality managed conflict better and were better off at managing large organizations.

Philips Campbell and Morrison (2010) conducted a research on satisfaction, stress and spousal support among 242 married veterans. Both genders reported that income and time required for work was the greatest dissatisfaction. Males reported more spousal support on their careers. They proposed a study on the interactive effect among combination of stressors that are commonly found in the world of work. No differences were found between the genders on the effect of work related stress.

Sultana (2012) carried out a study on the nature and impact of teacher stress in the private schools of Gilgit-Baltistan in Pakistan. Analysis of the findings of the study resulted in categorizing them into three groups: personal stress, professional stress and financial stress. However, the impact of each one of the three groups of teacher stress (i.e. personal, professional and financial) was different for different teachers. It looked like some teachers felt more stressed because of a variety of personal and domestic factors, whereas other teachers felt more constrained because of financial issues. Furthermore, the data analysis also highlighted the sources of teacher stress, which could be easily identified as the "inside-school" and the "outside-school" sources of stress. The various findings related to each one of the two categories are revealing as they show the significance and degree of enormity of stress factors related to these groups.

Blomme, Rheede and Tromp (2010) conducted a research on work life programmes and firm productivity among 658 US organizations. It was fully established that organizations that had extensive work life programmes enjoyed productivity benefits. They suggested further research that takes into accounts other organizational variables such as job satisfaction and organizational commitment.

Deaconu (2011) conducted a research on stress management and performance among 180 sales people. He established that Bio feedback and counselling enhanced performance of sales personnel.

Barnett (2004) conducted a research on work hours and stress outcomes among 211 dual income earner couples with children. He found that long hours of work had an effect on marital quality, psychological distress and work-family conflict. He proposed further research on the linkages both individually and within couples between long working hours and health behaviours such as regular exercises, routine medical checkups and healthy eating.

In Kenya a lot of research on causes of workers stress in educational institutions had focused on teachers. Gathungu and Wachira (2013) carried out a study on the job satisfaction factors that influence the performance of secondary school principals in their administrative functions in Mombasa district, Kenya. They

found out that the determinants of stress include job satisfaction, job enhancement, team work, promotion, cooperation, mentoring and training needs, the development, management and recognition of success.

Yambo, et al. (2012) focused on investigating high school principals' stress in relation to their job experience in schools in Southern Nyanza Region of Kenya. They found out that the sources of stress: Role Based, Task Based, Conflict Mediating and Boundary Spanning had a correlation and dependable relationship with High School Principals' job Experience in schools.

Mairura (2009) conducted a research on counselling, self-esteem and stress among 130 teenagers in Nairobi day schools. He found that counselling was effective in managing stress experienced by teenagers and raised their self-esteem. He suggested further research on the same area, expanding the approach to include a larger or more representative sample.

Obwogi (2011) conducted a research on the factors that affect quality of teaching staff in universities in Kenya supplementing Ngoma's research in 2010 on the massive growth of university education in East Africa and the challenges facing the sector from 2000 to 2011. From both studies it's clear that something is not right among the university workers and something needs to be urgently done even as the work load increases in the public universities.

In response to the issue of universities workers problems, Muceke (2012) observed that most of the studies on academic staff retention were based on the corporate sector. There was only one from the public universities done by Tetey in 2009. Muceke (2012) noted the problem of academic staff retention in Kenyan public universities is a pertinent issue and it is expected to be worse with the double intake in 2011/2012 academic year. Musyoka et al (2013) in their research on the role of stress management in reducing stress and enhancing corporate performance concluded that the Government of Kenya is responsible for all workers through the ministry of labour. It has the duty to set regulations on minimum pay, health and safety of workers among others. They suggest that FKE and COTU should come-up with regulations that will prevent or manage stress. They further suggest that Human Resources Manager who works in these corporations must be able to handle traumatic incidents, mediate conflict situations at work and organize for drug-alcohol abuse programmes for the staff. Getting in touch with employees brings the important aspect of social support which helps employees improve their perception and realize that they are valued, and in turn enhances their self-esteem and confidence at the work place. This translates to higher job performance among employees and is reflected by improvement of the measures of corporate performance such as customer satisfaction, employee creativity, productivity, higher market share and profitability. Critical to organizations supportive culture is sensitizing supervisors to be sympathetic to employees desire to seek balance between work and family needs. Finally managers should organize seminars for employees to educate them on time management, financial management, team work enhancing programmes and healthy living seminars in order to manage their own stress.

As established by many researchers for example Sayeed (2001), Deaconu (2011), Barnett (2004) etc, stress management

positively contribute to the performance of organizations. In this research, the researcher wishes to establish the determinants of stress in public Universities in Kenya, how stress affects performance and what the Universities have been doing to mitigate the stressors in the public Universities.

Studies on the determinants of stress have focused on one particular determinant at a time this therefore has left a gap of knowledge on the relationship between the specific determinants of stress. Since there are such gaps, dealing with workers stress completely has not been easy because the factors causing such stress is not addressed completely by the studies (Yambo, et al., 2012). This study therefore aims at identifying all the determinants of stress, showing the relationship between such stressors and identifying coping strategies to manage such stressors.

III. RESEARCH METHODOLOGY

This research adopted both exploratory and descriptive research designs. Creswell (2014) argues that a flexible research design which provides opportunity for considering many different aspects of a problem is considered if the purpose of the research study is that of exploration. When the purpose happens to be an accurate description of a situation or of an association between variables, the suitable design will be one that minimizes bias and maximizes the reliability of the data collected and analyzed (Kothari, 2004). Given this advice and the nature of this study, a non-experimental hypothesis testing design was adopted as most appropriate for this study. The study sought personal views, opinions, attitudes, and perceptions about causes of workers stress and their effect on the performance of the public universities which could be subjected to experimental design (Silverman, 2013).

The research design used for the study was a cross-sectional evaluation survey. This study collected information from workers in selected universities in Kenya thus making a survey effective in executing the research. An evaluation on the other hand involves the study of an organizational change, curriculum or innovation (Robert, 2002), which involved the evaluation of workers stress causative factors in public universities. However, the survey was cross-sectional survey since the data was collected at one particular time across the selected universities (Schurink, 2009). This research design was applied by the use of both suitable qualitative and quantitative research methods.

Quantitative research makes use of questionnaires, surveys and experiments to gather data that is revised and tabulated in numbers, which allows the data to be characterized by the use of statistical analysis (Denzin and Lincoln, 2005). Quantitative researchers measure variables on a sample of subjects and express the relationship between variables using effect statistics such as correlations, relative frequencies, or differences between means; their focus is to a large extent on the testing of theory. The study intended to establish the causes of workers stress and coping strategies which was collected using questionnaires. The factors were tabulated in the questionnaires and expressed using relative frequencies.

On the other hand, Creswell (2014) points out that there are several common characteristics of qualitative research, which includes: the data is collected in the field at the natural setting;

researcher is a key instrument and they also use multiple forms of data collection such as interviews, observations, and documents rather rely on a single data source. This study employed qualitative research while generating data from specific participants on causes and effects of stress on performance and their coping strategies using interviews.

The target population refers to the subjects who possess attributes which the researcher wishes to study and a universe of units from which the sample is to be drawn Devos (2000). Bless and Higson-Smith (1995), define a target population as a set of elements on which the researcher focuses and from which the results obtained by testing the sample can be generalized.

The target population for this study was the staff of three selected public universities in Kenya. This included Jomo Kenyatta University of Agriculture and Technology, University of Nairobi, and Kenyatta University. This refers to the individual workers; in all levels of employment, at the selected higher institutions as well as representatives from the staff welfare department and the institutions' administration in charge of human resources. Various departmental heads are also targeted as their responsibilities from time to time involve human resources management. This gave a total target population of 12,805 workers from the three selected public universities as shown on table 3.1 below.

Table 3.1: Population of Workers in the Selected Public Universities

Selected public universities	University workers population
Jomo Kenyatta University of Agriculture and Technology	2,131
University of Nairobi	4,874
Kenyatta University	5,800
TOTAL	12,805

Source : (KUSU, 2014)

Cluster sampling technique was employed for the survey. The cluster sampling design involves the dividing of the population into mutually exclusive groups and then drawing random samples from each group to interview (Kumar R, 2005). This was necessary so as to ensure that the samples selected from each group are represented in the entire sample, which was selected for the study, in proportion to their numbers in the entire targeted population.

The Fishers formula was used to determine the appropriate sample size of this study. This was because the target population consists of a large number of units (public university workers) (Yates, 2004). The researcher assumed 95% desired level of confidence, which is equivalent to standardized normal deviate value of 1.96, and an acceptable margin of error of 5% (standard value of 0.05).

$$n = Z^2pq/d^2$$

Where:

n = the desired sample size (if target population is large)

z = the standard normal deviate at the required confidence level.
P = the proportion in the target population estimated to have characteristic being measured.

$$q = 1-p$$

d = the level of statistical significance set.

Assuming 50% of the population have the characteristics being measured, $q=1-0.3$

Assuming we desire accuracy at 0.05 level. The Z-statistic is 1.96 at this level

$$\text{Therefore } n = (1.96)^2(.5)(.5)/(.05)^2 = 384$$

The targeted respondents from the selected public universities were categorized into three groups. These groups will include: The academic staff; the administrative staff; and the operative staff.

The cluster samples from the three selected universities were composed of respondent workers as shown on table 3.2.

Table 3.2: Composition of the Cluster Samples

Selected Universities	Public	Academic staff		Administrative staff		Operative staff		Total Respondents	
		Actual	Cluster	Actual	Cluster	Actual	Cluster	Actual	Cluster
JKUAT		702	21	923	28	506	15	2,131	64
University of Nairobi		1,411	42	1,647	49	1,816	55	4,874	146
Kenyatta University		900	27	1,700	51	3,200	96	5,800	174
GRAND TOTAL		3,013	90	4270	128	5,522	166	12,805	384

The data collection tools used for the study were a questionnaire and interview schedules to obtain data from primary sources and a document review and analysis for secondary sources. These tools were selected after carefully considering the nature of the data to be collected, the target

population, the time frame and the objectives/ research questions of the study.

a) Interviews

Interviews were important in situations where we cannot observe behaviour or when we do not know how participants experience their world (Cohen et al., 2007). Face-to-face

interviews allowed the researcher an opportunity to explore the meaning participants attach to their experiences (Richards, 2003) in causes of their stress and how they are coping with such stress situations. Face-to-face interview as well allowed the researcher to observe non-verbal cues and appropriately react or modify his inquiry in response to non-verbal cues (Yin, 2003) of participants particularly when they elicit confusion, uncertainty, or waning motivation.

The interviews were based on a prepared set of questions but these were only used as a guide. The research took the same position as Silverman (2013), that in qualitative study, questions are only used as a guide and departures from the guidelines are not seen as a problem but are often encouraged. The interview schedules involved the interviews of some key informants from the selected institutions of higher learning who are in one way or another involved in the welfare of the workers.

b) Questionnaires

Questionnaire has the advantage of being taken to a wider audience compared to interviews, but has a disadvantage of not being possible to customize it to individuals as it is possible with other methods of data collection. The questionnaire was the main data collection tool and it contained both open ended and closed ended questions. This study used two questionnaires that included: Self-evaluation of the determinants of workers' stress (Appendix 1) which was taken by participants in the pilot as well as the actual study to investigate the causes and effects of occupational stress among university workers; this questionnaire also attempted to determine their attitude towards such factors; and Self-evaluation of the effects of the stress factors on their performance and coping strategies employed by the workers in dealing with their stress and stressful situation, was taken by the participants during the actual study.

Primary data was gathered using interview guides and questionnaires which were self-administered. Cooper & Schindler (2004) state that self-administered interviews help to reach a large number of potential respondents in different locations. The questionnaires also helped to collect data from a large population of respondents at a short period of time.

The questionnaire and interview schedule were used to obtain both qualitative and quantitative data from the targeted respondents. Primary data collection was conducted by research assistants and me because of the different locations of institutions of higher learning. The data was collected over a period of one month to be able to meet the requirements of a cross-sectional survey. Secondary data was obtained from literature review and documents about workers stress in institutions of higher learning. The questionnaires with open ended questions on workers stress in public universities in Kenya were administered to selected workers representatives within the selected public universities in Kenya. This informed the second phase of data generation.

The second phase involved: a) administering questionnaires to the respondents who included university workers in the selected public universities; and b) conducting interviews with some key informants from the selected institutions of higher learning who are in one way or another involved in the welfare of the workers by use of interview guides. The questionnaires and the interview guides contained questions on the major issues raised in first phase.

Kombo and Tromp (2006) posit that after constructing a research instrument or questionnaire the researcher should try it out on a small sample of the population. This way of pre-testing or piloting of the instrument enables the researcher to ensure that the questions measure what they are supposed to; that the wording is very clear and unambiguous; that the questions provoke the intended responses and the researcher was able to analyze and know whether the questions posed are skewed towards certain issues more than others.

The questionnaire was pretested before its administration to ensure validity and reliability of the data to be collected. Validity was determined by the use of face validity and content validity. Face validity tests if the questions appear to be measuring the intended sections. On the other hand, content validity tests whether all the important aspects of the sections are measured. This was done by first testing the instruments on 10% of the target population and reviewing the findings. Reliability of the responses was tested using the Cronbach alpha. Normally, α should be between 0.7 – 0.9 (Santos, 1999).

Data processing operations carried out included data editing/ cleaning and classification. Data editing/ cleaning is the examination of the collected data so as to detect omissions and errors and to correct them whenever possible. Data classification is the arranging of the collected data in classes or groups with common characteristics. The similar data was then tabulated before further analysis is conducted.

The tabulated data was then analyzed using both qualitative and quantitative techniques. Descriptive statistics was used for the analysis of the collected data, and this included parameters such as measures of central tendencies and the measure of dispersion. Inferential data analysis techniques such as regression and correlation analysis were also used to analyze the collected data. These parameters were used to determine and evaluate the relationships of the variables being measured. Data analysis and presentation of findings was carried out using statistical software which includes SPSS version 24 and Microsoft Excel. These software aided in the generation of suitable graphs, charts and tables which were used in drawing conclusions as well as presenting the research findings.

Regression is an important approach to modelling the relationship between the dependent variable (y) and one or more independent variable (x). A regression equation describes how the mean value of a response variable relates to specific values of the predictor variables (Bhattacharyya, 2011). The study used logistic regression analysis to test the statistical significance of the independent variables on the dependent variables.

Logistic regression is used to refer specifically to the problem in which the dependent variable is [binary](#), that is, the number of available categories is two (Hosmer and Stanley, 2000). The probabilities describing the possible outcomes of a single trial were modelled, as a function of the explanatory variables, using a [logistic function](#) (Hosmer and Stanley, 2000). Logistic regression was therefore used to measure the relationship between the categorical dependent variable and the independent variables by using probability scores as the predicted values of the dependent variable (Agresti, 2002).

The study used Binomial logistic regression. Binomial logistic regression refers to the instance in which the observed outcome can have only two possible types (Greene, 2003). The

outcomes were coded as "0" and "1", as this lead to the most straightforward interpretation. The target group, the workers whose performance is affected (referred to as a "case") were coded as "1" and the reference group, workers whose performance is not affected (referred to as a "non-case") was coded as "0".

Logistic regression was used for predicting binary outcomes rather than continuous outcomes. It takes natural logarithm off the odds (logit or log-odds) to create a continuous criterion. The logit of success was then fitted to the predictors using regression analysis (Howell, 2010). The results of the logit were converted back to the odds via the inverse of the natural logarithm. Although the observed variables in logistic regression are categorical, the predicted scores were modelled as a continuous variable (the logit). The logit is referred to as the *link function* in logistic regression – although the output in logistic regression is binomial and displayed in contingency table, the logit is an underlying continuous criterion upon which linear regression was conducted (Howell, 2010).

Faraway (2002), states that regression analysis is a statistical tool for the investigation of relationships between variables. Regression methods have become an integral component of any data analysis concerned with describing the relationship between a response variable and explanatory variables (Hosmer and Stanley, 2000).

The logistic regression equations for performance of workers being affected was expressed as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e \tag{3.1}$$

Where; Y = Performance of workers being affected.

β_0 = Is the constant or coefficient of intercept.

X_1 = Workplace relationships stress.

X_2 = Management stress.

X_3 = Movement stress.

$\beta_1 \dots \beta_3$ = The corresponding coefficients for the respective variables.

Regression analysis was used by Gathungu and Wachira (2013) who studied the job satisfaction factors that influence the performance of secondary school principals in their administrative functions in Mombasa district, and Obwogi (2011) who studied the factors that affect quality of teaching staff in universities in Kenya.

The study was guided by independent variables; Workplace relationships, Management stress, and Movement stress. Working facilities stress was measured by evaluating respondent's opinions on the contribution of the physical

facilities available on their environment and the working conditions on their workplace stress.

Workplace relationships stress was measured by assessing the contribution of the relationships with the boss, subordinates or colleagues and difficulties in delegating responsibilities among the workers. Their opinions were measured in a likert scale containing statements that indicate the contribution of relationships to workers' stress. Management stress was measured based on the respondents' opinion on the contribution of organizational structure, ambiguity of roles, and participation in decision-making on workers' stress.

Movement stress was measured by determining the respondents' opinion on the contribution of job shifts, job transfers and replacements on workers stress while motivation stress was measured by assessing the contribution of under promotion, over promotion and Lack of job security on the stress of the workers.

The dependent variable for the study was the performance of the selected public university workers. The workers performance was measured by assessing the physiological and psychological responses that are attributed to exposure to a stress factor.

IV. RESEARCH FINDINGS AND DISCUSSION

This chapter presents the raw data of the research findings and discusses the findings. Univariate and multivariate statistical measures were both employed in analysis of the data.

Respondents were asked to rate their worker's relationship in the organization based on various attributes on a five point likert scale. There exists a good relationship between the workers/colleagues at place of work/office as supported by 78% of the respondents. Another 78% of the respondents supported the assertion that their colleagues are supportive in case of a problem at place of work. Two thirds of the respondents felt that staff welfare committee is supportive and follows up on the concerns of the employees. On the other hand 63% of the respondents agreed that when issues are forwarded to the welfare section/committee, they are acted upon promptly. Slightly over half of the respondents (57%) supported the statement that members of the welfare section/committee are supportive in case of a problem. The organization staff welfare committee is effective in matters relating to employees welfare was supported most (78%) of the respondents. Respondents were observed to disagree with the statements on "The disciplinary actions in my institutions are relevant and reasonable to their respective punishable actions" and "The current disciplinary procedure is relatively fair as it is" with 61% and 72% either neutral or disagreeing with the statements respectively.

Table 4.1: Worker's Relationship

Variable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
There exists a good relationship between the workers or colleagues at my place of work or office	1%	0%	22%	61%	17%
My colleagues are supportive in case of a problem at my place of work	3%	3%	15%	40%	38%
Staff welfare committee is supportive and follows up on the concerns of the employees	20%	4%	9%	17%	50%

When issues are forwarded to the welfare section or committee, they are acted upon promptly	1%	1%	34%	55%	8%
Members of the welfare section or committee are supportive in case of a problem	4%	13%	26%	24%	33%
The organization staff welfare committee is effective in matters relating to employees welfare	1%	11%	10%	25%	53%
The disciplinary actions in my institutions are relevant and reasonable to their respective punishable actions	2%	25%	35%	32%	7%
The current disciplinary procedure is relatively fair as it is	17%	33%	22%	25%	3%

To provide a comparative description for the responses across the three universities, the average for each statement were obtained as shown below. Great discrepancies among the respondents from the three universities were not observed. However, Staff welfare committee support was of concern to UoN respondents as shown by low score.

Table 4.2: Worker’s Relationship by University

Variable	University			
	Total	JKUAT	UoN	KU
b1 There exists a good relationship between the workers or colleagues at my place of work or office	3.9	3.9	3.9	3.9
b2 My colleagues are supportive in case of a problem at my place of work	4.1	4.2	4.1	4.0
b3 Staff welfare committee is supportive and follows up on the concerns of the employees	3.7	4.0	3.4	4.0
b4 When issues are forwarded to the welfare section or committee, they are acted upon promptly	3.7	3.7	3.7	3.7
b5 Members of the welfare section or committee are supportive in case of a problem	3.7	3.8	3.7	3.7
b6 The organization staff welfare committee is effective in matters relating to employees welfare	4.2	4.0	4.2	4.2
b7 The disciplinary actions in my institutions are relevant and reasonable to their respective punishable actions	3.2	3.1	3.2	3.2
b8 The current disciplinary procedure is relatively fair as it is	3.5	4.4	3.2	3.5
Average	3.8	3.9	3.7	3.8

Factor analysis for Worker’s Relationship

Factor analysis was best suited for this research to enable reduction of the data items into few significant composite variables affecting performance of employees in public universities in Kenya. The composite variables were used in presenting, analysis, interpretation and discussions.

Worker’s Relationship in this study was evaluated using 8 items. The five point likert scale of (8) data items, was used to measure and determine the extent to which Worker’s Relationship comprised of the desired outcomes. A correlation

was first done on all the data items under Worker’s Relationship and only those that significantly correlated to each other were further reduced into few principal components. Results from correlations showed that “Staff welfare committee is supportive and follows up on the concerns of the employees-b3” and “The current disciplinary procedure is relatively fair as it is-b8” did not correlate with most of other items and were therefore eliminated before running factor analysis.

Table 4.3: Correlations for Worker’s Relationship

Statistic	b1	b2	b3	b4	b5	b6	b7	b8
b1 Pearson Correlation	1	.486**	-.023	.208**	.298**	.229**	.262**	-.049
Sig. (2-tailed)		.000	.661	.001	.000	.000	.000	.355
N	354	354	350	274	285	285	285	354
b2 Pearson Correlation	.486**	1	-.025	-.073	.515**	.414**	.280**	-.019
Sig. (2-tailed)	.000		.644	.226	.000	.000	.000	.718

	N	354	354	350	274	285	285	285	354
b3	Pearson Correlation	-.023	-.025	1	.035	.084	.127*	-.015	.060
	Sig. (2-tailed)	.661	.644		.571	.158	.033	.808	.265
	N	350	350	350	272	283	283	283	350
b4	Pearson Correlation	.208**	-.073	.035	1	.376**	.444**	.482**	-.023
	Sig. (2-tailed)	.001	.226	.571		.000	.000	.000	.702
	N	274	274	272	274	274	274	274	274
b5	Pearson Correlation	.298**	.515**	.084	.376**	1	.636**	.296**	.112
	Sig. (2-tailed)	.000	.000	.158	.000		.000	.000	.059
	N	285	285	283	274	285	285	285	285
b6	Pearson Correlation	.229**	.414**	.127*	.444**	.636**	1	.489**	-.054
	Sig. (2-tailed)	.000	.000	.033	.000	.000		.000	.365
	N	285	285	283	274	285	285	285	285
b7	Pearson Correlation	.262**	.280**	-.015	.482**	.296**	.489**	1	-.113
	Sig. (2-tailed)	.000	.000	.808	.000	.000	.000		.057
	N	285	285	283	274	285	285	285	285
b8	Pearson Correlation	-.049	-.019	.060	-.023	.112	-.054	-.113	1
	Sig. (2-tailed)	.355	.718	.265	.702	.059	.365	.057	
	N	354	354	350	274	285	285	285	354

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

The next table is used as to test assumptions; essentially, the Kaiser-Meyer-Olkin (KMO) statistic should be greater than 0.500 and the Bartlett's test should be significant (e.g. $p < .05$). KMO is used for assessing sampling adequacy and evaluates the correlations and partial correlations to determine if the data are likely to coalesce on factors (i.e. some items highly correlated, some not). The Bartlett's test evaluates whether or not our correlation matrix is an identity matrix (1 on the diagonal & 0 on

the off-diagonal). The Kaiser-Meyer-Olkin of sampling adequacy was above the threshold of 0.5 (KMO=0.612) indicating that the sample size was adequate for the variables entered into analysis. The Bartlett's Test of Sphericity was significant ($\chi^2=609.876$, $df=15$, $P<0.001$) showing that factor analysis using principal component was relevant for the data set and there were some relationships between the variables.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.612
Bartlett's Test of Sphericity	Approx. Chi-Square	609.876
	Df	15
	Sig.	.000

The table below shows the eigen values (variances of the principal components) associated with each linear component (factor) before extraction, after extraction and after rotation. The

rotations converged in two iterations with two significant components with Eigen values accounting for 68.397% of the variance explained.

Total Variance Explained

Component	Initial Eigenvalues		Extraction Sums of Squared Loadings		Sums of Rotation Sums of Squared Loadings	
	Total	% of Cumulative Variance %	Total	% of Cumulative Variance %	Total	% of Cumulative Variance %
1	2.865	47.743	2.865	47.743	2.150	35.832

2	1.239	20.654	68.397	1.239	20.654	68.397	1.954	32.565	68.397
3	.798	13.297	81.694						
4	.589	9.811	91.506						
5	.302	5.026	96.532						
6	.208	3.468	100.000						
Extraction Method:		Principal Component Analysis.							

Being above the threshold of 50% it indicated that the two-component factor model derived fitted the data appropriately. Items loading greater than 0.5 for each component combined to form the two principal components and the variables that clustered into each are shown in table below.

Table 4.4: Rotated Component Matrix

Variable	Component	
	1	2
b1 There exists a good relationship between the workers or colleagues at my place of work or office	.133	.725
b2 My colleagues are supportive in case of a problem at my place of work	.053	.932
b4 When issues are forwarded to the welfare section or committee, they are acted upon promptly	.878	-.131
b5 Members of the welfare section or committee are supportive in case of a problem	.568	.567
b6 The organization staff welfare committee is effective in matters relating to employees welfare	.717	.421
b7 The disciplinary actions in my institutions are relevant and reasonable to their respective punishable actions	.722	.209

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Correlation between worker’s relationship and performance was done and results displayed in the table below.

Table 4.5: Correlation between Worker’s Relationship and performance

	Not depressed	Don’t feel and boredom	Does lazy possible job	Enjoy work	Job Commitment	Responsible for actions at work	Motivated productive and creative	Stress produce poor work	Stress reduces productivity	Employee morale	Serves the customer efficiently	Productive work	Efficient service delivery
b1	-.015	.102	-.043	.151*	.011	-.038	.426**	.198**	.078	.161**	-.201**	-.120*	-.053
b2	-.010	-.021	-.019	-.016	.128*	-.146**	.058	.015	-.157**	.108*	.088	.095	-.018
b3	-.017	.083	-.020	-.005	.079	.035	-.087	-.050	-.020	-.036	.085	.056	-.003
b4	-.044	.122*	.028	.035	-.195**	-.012	.445**	.202**	.305**	.105	-.101	-.140*	.259**
b5	.138*	.156*	.021	.162*	-.016	.017	.254**	.089	.024	.141*	-.032	.051	.172**
b6	-.045	.325**	-.031	.133*	-.130*	-.010	.268**	.165**	.071	.217**	-.035	-.004	.359**
b7	.086	.099	.075	.128*	-.130*	.194**	.353**	.106	.362**	.332**	-.257**	-.267**	.162**
b8	.038	.112*	-.091	.173*	.075	-.148**	.077	-.107*	-.156**	.074	-.017	.042	.109*

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Respondents were not depressed and could perform effectively with significance at 0.05 levels for supportive members of the welfare section/committee (.138). This shows that lack of members of the welfare section/committee support is

perceived to cause depression and inability to perform effectively among university employees. However, it was not significant for good relationship between the workers/ colleagues at my place of work/ office (-.015), My colleagues are supportive in case of a problem at my place of work (-.010), staff welfare committee is supportive and follows up on the concerns of the employees (-.017) and when issues are forwarded to the welfare section /committee, they are acted upon promptly (-.044).

I do not always feel lazy, boredom and headache lowering output was significant for the statements that “When issues are forwarded to the welfare section or committee, they are acted upon promptly (.122)”, “Members of the welfare section or committee are supportive in case of a problem (.156)”, “The organization staff welfare committee is effective in matters relating to employees welfare and can perform effectively (.325)” and “The current disciplinary procedure is relatively fair as it is (.112)”. This shows that an effective staff welfare committee and fair disciplinary procedures can reduce stress from laziness, boredom and headache which lowers output.

I do the best possible job was not significant for any of the statements. I enjoy my work was significant for the statements that “There exists a good relationship between the workers or colleagues at my place of work or office (.151)”, “Members of the welfare section or committee are supportive in case of a problem (.162)”, “The organization staff welfare committee is effective in matters relating to employees welfare (.133)”, “The

disciplinary actions in my institutions are relevant and reasonable to their respective punishable actions (.128)” and “The current disciplinary procedure is relatively fair as it is (.173)”. These correlations show that employees enjoy their work most when there are healthy relationships among them.

To assess management respondents were presented with a list of statements on a five point likert scale and asked to rate their agreement with each. 51% of the respondents, agreed to be aware of their organization structure. More than half of the respondents (54%) were either neutral or disagreed with the statement on their Organization Structure being appropriate. Most of the respondents (79%) agreed that people are held accountable for the quality of work they produce. Two thirds of the respondents agreed that their supervisor asks for their input to help make decisions. More than half of the respondents (59%) supported the statement that their supervisor tells them when they do their work well. However, most of the respondents (55%) disagreed with the statement that their supervisor tells them when their work needs improvement. More than two thirds (69%) of the respondents agreed that their supervisor delegates work effectively. On the other hand slightly more than half of the respondents (53%) felt adequately utilized in their job. Management is sensitive to employee problems was agreed upon by 53% of the respondents while another 57% agreed to being involved in decision making in their organization.

Table 4.6: Management

Variable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am aware of my Organization Structure	6%	20%	23%	39%	12%
The Organization Structure is appropriate	10%	19%	25%	32%	14%
People are held accountable for the quality of work they produce	6%	9%	6%	43%	36%
My supervisor asks for my input to help make decisions	2%	10%	21%	37%	30%
My supervisor tells me when I do my work well	4%	10%	27%	31%	28%
My supervisor tells me when my work needs improvement	12%	20%	23%	33%	12%
My supervisor delegates work effectively	2%	16%	12%	49%	20%
I feel adequately utilized in my job	4%	14%	29%	49%	4%
Management is sensitive to employee problems	8%	10%	28%	39%	14%
I am involved in decision making in my organization	8%	12%	23%	47%	10%

Segregation by respondent’s University, great discrepancies in responses were not observed.

Table 4.7: Management by University

Variable	University			
	Total	JKUAT	UoN	KU
f1 I am aware of my Organization Structure	3.3	3.3	3.3	3.3
f2 The Organization Structure is appropriate	3.2	3.1	3.2	3.2
f3 People are held accountable for the quality of work they produce	3.9	3.9	4.0	4.0
f4 My supervisor asks for my input to help make decisions	3.8	3.8	3.8	3.8
f5 My supervisor tells me when I do my work well	3.7	3.8	3.7	3.7
f6 My supervisor tells me when my work needs improvement	3.1	3.2	3.1	3.1

f7	My supervisor delegates work effectively	3.7	3.6	3.7	3.7
f8	I feel adequately utilized in my job	3.4	3.4	3.3	3.3
f9	Management is sensitive to employee problems	3.4	3.5	3.4	3.4
f10	I am involved in decision making in my organization	3.4	3.3	3.4	3.4
Average		3.4	3.2	3.5	3.3

Management in this study was evaluated using 10 items. The five point likert scale of (10) data items, was used to measure and determine the extent to which management comprised of the desired outcomes. A correlation was first done on all the data items under management and only those that significantly correlated to each other were further reduced into

few principal components. Results from correlations showed that “The Organization Structure is appropriate-f2” and “f3 People are held accountable for the quality of work they produce-f3” did not correlate with most of other items and was therefore eliminated before running factor analysis.

Table 4.8: Correlations among management items

Statistic	f1	f2	f3	f4	f5	f6	f7	f8	f9	f10
f1 Pearson Correlation	1	.208**	.013	.509**	.295**	.159**	-.139**	.443**	.466**	.180**
f1 Sig. (2-tailed)		.000	.806	.000	.000	.003	.009	.000	.000	.001
f1 N	354	354	354	354	354	354	354	354	354	354
f2 Pearson Correlation	.208**	1	-.049	.016	.009	.126*	.290**	-.089	.138**	.019
f2 Sig. (2-tailed)	.000		.355	.770	.871	.018	.000	.096	.009	.725
f2 N	354	354	354	354	354	354	354	354	354	354
f3 Pearson Correlation	.013	-.049	1	.378**	.091	.221**	.138**	.230**	.092	.342**
f3 Sig. (2-tailed)	.806	.355		.000	.089	.000	.009	.000	.083	.000
f3 N	354	354	354	354	354	354	354	354	354	354
f4 Pearson Correlation	.509**	.016	.378**	1	.424**	.310**	-.108*	.409**	.452**	.495**
f4 Sig. (2-tailed)	.000	.770	.000		.000	.000	.043	.000	.000	.000
f4 N	354	354	354	354	354	354	354	354	354	354
f5 Pearson Correlation	.295**	.009	.091	.424**	1	.097	-.173**	.329**	.356**	.323**
f5 Sig. (2-tailed)	.000	.871	.089	.000		.067	.001	.000	.000	.000
f5 N	354	354	354	354	354	354	354	354	354	354
f6 Pearson Correlation	.159**	.126*	.221**	.310**	.097	1	-.128*	.185**	.432**	.400**
f6 Sig. (2-tailed)	.003	.018	.000	.000	.067		.016	.000	.000	.000
f6 N	354	354	354	354	354	354	354	354	354	354
f7 Pearson Correlation	-.139**	.290**	.138**	-.108*	-.173**	-.128*	1	-.024	-.169**	-.010
f7 Sig. (2-tailed)	.009	.000	.009	.043	.001	.016		.649	.001	.854
f7 N	354	354	354	354	354	354	354	354	354	354
f8 Pearson Correlation	.443**	-.089	.230**	.409**	.329**	.185**	-.024	1	.168**	.115*
f8 Sig. (2-tailed)	.000	.096	.000	.000	.000	.000	.649		.002	.030
f8 N	354	354	354	354	354	354	354	354	354	354
f9 Pearson Correlation	.466**	.138**	.092	.452**	.356**	.432**	-.169**	.168**	1	.246**
f9 Sig. (2-tailed)	.000	.009	.083	.000	.000	.000	.001	.002		.000
f9 N	354	354	354	354	354	354	354	354	354	354
f10 Pearson Correlation	.180**	.019	.342**	.495**	.323**	.400**	-.010	.115*	.246**	1
f10 Sig. (2-tailed)	.001	.725	.000	.000	.000	.000	.854	.030	.000	
f10 N	354	354	354	354	354	354	354	354	354	354

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

The Kaiser-Meyer-Olkin of sampling adequacy was above the threshold of 0.5 (KMO=0.669) indicating that the sample size was adequate for the variables entered into analysis. The Bartlett's Test of Sphericity was significant ($\chi^2=699.742$, $df=28$,

$P<0.001$) showing that factor analysis using principal component was relevant for the data set and there were some relationships between the variables.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.669
Bartlett's Test of Sphericity	Approx. Chi-Square	699.742
	Df	28
	Sig.	.000

The table below shows the eigenvalues (variances of the principal components) associated with each linear component (factor) before extraction, and after extraction. The extraction

converged in three iterations with one significant component with Eigenvalues accounting for 64.812% of the variance explained.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% Variance	of Cumulative %	Total	% Variance	of Cumulative %	Total	% Variance	of Cumulative %
1	3.026	37.829	37.829	3.026	37.829	37.829	2.227	27.833	27.833
2	1.127	14.081	51.910	1.127	14.081	51.910	1.838	22.978	50.811
3	1.032	12.901	64.812	1.032	12.901	64.812	1.120	14.001	64.812
4	.847	10.583	75.394						
5	.711	8.889	84.283						
6	.598	7.479	91.762						
7	.375	4.682	96.444						
8	.284	3.556	100.000						

Extraction Method: Principal Component Analysis.

Being above the threshold of 50% it indicated that the one-component factor model derived fitted the data appropriately. Items loading greater than 0.5 for the component combined to

form the one principal component and the variables that clustered into it are shown in table below. The third component comprised of one item which was eliminated further analysis.

Table 4.9: Rotated Component Matrix

Variable	Component		
	1	2	3
f1	.775	.103	-.172
f4	.661	.501	-.008
f5	.606	.210	-.162
f6	.024	.795	-.167
f7	-.060	-.011	.923
f8	.790	-.025	.127
f9	.405	.515	-.374
f10	.173	.797	.170

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 4 iterations.

The effect of management on performance and was examined by calculating the correlations.

Table 4.10: Correlation between management and performance

	Not depressed	Don't feel and boredom	Does the best possible job	Enjoy work	Job Commitment	Responsible for actions at work	Motivated , productive and creative	Stress produces poor productivity	Stress reduces productivity	Employees have high morale	Serves the customer efficiently	Productive accurate work	Efficient service delivery
f1	.114*	.031	-.068	.008	.012	.056	-.027	-.046	.051	-.007	-.015	-.038	-.125*
f2	.152**	-.032	.092	.078	-.097	-.058	.096	-.041	.059	.051	-.091	-.036	-.138*
f3	.132*	-.016	-.008	-.035	.123*	.008	-.027	-.006	-.024	-.068	.003	.021	-.077
f4	.156**	.037	-.027	-.045	.021	.107*	-.018	-.057	.020	-.030	-.018	-.045	-.059
f5	.207**	.028	.001	-.064	.010	.098	-.068	-.014	-.097	-.095	-.084	-.093	-.110*
f6	.299**	.049	.082	.005	.078	.008	.069	-.042	-.070	.025	-.087	-.097	-.097
f7	.153**	-.091	.008	.025	-.033	-.003	.014	-.018	.045	.037	.000	.013	.072
f8	.019	-.077	-.036	-.084	-.016	.006	-.101	-.029	-.073	-.028	.126*	.073	.022
f9	.057	.133*	.011	.054	.045	.074	.123*	-.039	.034	-.047	-.216**	-.150**	-.178**
f10	.088	.060	.113*	-.002	.042	.165**	-.015	-.043	.023	-.030	-.126*	-.170**	-.081

*. Correlation is significant at the 0.05 level (2-tailed).

** . Correlation is significant at the 0.01 level (2-tailed).

Results showed that lack of depression and effective performance was positively and significantly correlated to being aware of Organization Structure (.114); organization Structure being appropriate (.152); People being held accountable for the quality of work they produce (.132); supervisor asking for employees' input to help make decisions (.156); supervisor telling employees when they do my work well(.207); supervisor telling employees when their work needs improvement (.299); and supervisor delegating work effectively (.153).

Being committed to their jobs was positively and significantly correlated to People being held accountable for the quality of work they produce (.123). Taking responsibility for our actions within the job environment was positively and significantly correlated to supervisor asking for employees' input to help make decisions (.107) and being involved in decision making in their organization (.165). Having efficient service delivery was significantly correlated to being aware of organization structure (-.125) and organization Structure being appropriate (-.138).

To evaluate employee performance, respondents were presented with 13 statements on five point likert scale and asked to rate their agreement with each statement. From the results

most of the respondents (74%) agreed that they are not aggressive and depressed at work and therefore can perform duties effectively. Slightly over half of the respondents (55%) agreed that they do not always feel lazy, boredom and headache lowering their output. Surprisingly more than two thirds of the respondents (68%) agreed to not doing their best possible job. Over half of the respondents (53%) agreed that they enjoy their work. We are committed to our jobs was supported by 53% of the respondents. Most of the respondents (63%) disagreed that they take responsibility for their actions within the job environment. More than three quarters of the respondents (80%) admitted to being always motivated, productive and creative. Stress makes me produce poor quality work was agreed upon by 85% of the respondents while 81% agreed that stress reduces their productivity at work. On the other hand 60% of the respondents disagreed that employees in their University have high morale or commitment. Most of the respondents (57%) disagreed that they are able to serve the customers efficiently while 53% disagreed to being able to produce accurate work as expected by their organization. We have acquired efficient service delivery and quality of services in this University was disagreed by 60% of the respondents.

Table 4.11: Employee Performance

Variable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am not aggressive and depressed at work and therefore can perform my duties effectively	7%	8%	12%	34%	40%
I do not always feel lazy, boredom and headache lowering my output	0%	8%	37%	31%	23%
You do not do the best possible job	5%	11%	16%	40%	28%

I enjoy my work	11%	17%	19%	34%	19%
We are committed to our jobs	12%	15%	21%	43%	10%
We take responsibility for our actions within the job environment	18%	26%	19%	21%	16%
We are always motivated, productive and creative	0%	5%	16%	51%	29%
Stress makes me produce poor quality work	1%	1%	13%	53%	32%
Stress reduces my productivity at work	0%	5%	15%	53%	28%
Employees in this University have high morale or commitment	4%	31%	25%	28%	12%
I am able to serve the customers efficiently	17%	18%	22%	33%	10%
I am able to produce accurate work as expected by my organization	14%	14%	26%	39%	8%
We have acquired efficient service delivery and quality of services in this University	13%	22%	24%	28%	12%

To provide a comparative description for the responses obtained as shown below. Great discrepancies among the across the three universities, the average for each statement were respondents from the three universities were not observed.

Table 4.12: Employee Performance

Variable	Total	University		
		JKUAT	UoN	KU
g1 I am not aggressive and depressed at work and therefore can perform my duties effectively	3.9	4.0	4.0	3.8
g2 I do not always feel lazy, boredom and headache lowering my output	3.7	3.6	3.7	3.7
g3 You do not do the best possible job	3.8	3.2	3.8	3.9
g4 I enjoy my work	3.3	3.3	3.2	3.5
g5 We are committed to our jobs	3.2	3.2	3.3	3.2
g6 We take responsibility for our actions within the job environment	2.9	2.8	2.8	3.0
g7 We are always motivated, productive and creative	4.0	4.0	4.0	4.1
g8 Stress makes me produce poor quality work	4.1	4.1	4.1	4.2
g9 Stress reduces my productivity at work	4.0	4.0	4.0	4.1
g10 Employees in this University have high morale or commitment	3.1	3.0	3.1	3.2
g11 I am able to serve the customers efficiently	3.0	3.2	3.1	2.9
g12 I am able to produce accurate work as expected by my organization	3.1	3.2	3.2	3.0
g13 We have acquired efficient service delivery and quality of services in this University	3.0	2.9	3.0	3.1
Average	3.4	3.2	3.4	3.5

Factor analysis for Employee Performance

Employee Performance in this study was evaluated using 13 items. The five point likert scale of (13) data items, was used to measure and determine the extent to which Employee Performance comprised of the desired outcomes. A correlation was first done on all the data items under Employee Performance and only those that significantly correlated to each other were further reduced into few principal components. Results from correlations showed that “I am not aggressive and depressed at work and therefore can perform my duties effectively-g1”, “You do not do the best possible job-g3”, “We are committed to our jobs-g5” and “ Stress reduces my productivity at work-g9” did

not correlate with most of other items and was therefore eliminated before running factor analysis, Table 4.67 in the appendix.

The Kaiser-Meyer-Olkin of sampling adequacy was above the threshold of 0.5 (KMO=0.540) indicating that the sample size was adequate for the variables entered into analysis. The Bartlett’s Test of Sphericity was significant ($\chi^2=646.288$, $df=36$, $P<0.001$) showing that factor analysis using principal component was relevant for the data set and there were some relationships between the variables.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.540
Bartlett's Test of Sphericity	Approx. Chi-Square	646.288
	Df	36
	Sig.	.000

The table below shows the eigenvalues (variances of the principal components) associated with each linear component (factor) before extraction, after extraction and after rotation. The rotations converged in four iterations with four significant components with Eigenvalues accounting for 62.319% of the variance explained.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% Variance	% of Cumulative	Total	% Variance	% of Cumulative	Total	% Variance	% of Cumulative
1	2.311	25.673	25.673	2.311	25.673	25.673	2.027	22.521	22.521
2	2.010	22.331	48.004	2.010	22.331	48.004	1.822	20.245	42.766
3	1.288	14.315	62.319	1.288	14.315	62.319	1.760	19.553	62.319
4	.943	10.477	72.796						
5	.755	8.386	81.183						
6	.630	6.995	88.178						
7	.526	5.849	94.027						
8	.310	3.443	97.470						
9	.228	2.530	100.000						

Extraction Method: Principal Component Analysis.

Being above the threshold of 50% it indicated that the two-component factor model derived fitted the data appropriately. Items loading greater than 0.6 for each component, except for e11, combined to form the four principal components and the variables that clustered into each are shown in table below.

Table 4.13: Rotated Component Matrix

Variable	Component		
	1	2	3
g2 I do not always feel lazy, boredom and headache lowering my output	-.225	.731	-.009
g4 I enjoy my work	-.171	-.094	.772
g6 We take responsibility for our actions within the job environment	-.467	.309	-.553
g7 We are always motivated, productive and creative	-.085	.451	.638
g8 Stress makes me produce poor quality work	.079	.684	-.034
g10 Employees in this University have high morale or commitment	.161	.553	.574
g11 I am able to serve the customers efficiently	.886	-.021	-.134
g12 I am able to produce accurate work as expected by my organization	.873	.029	-.002
g13 We have acquired efficient service delivery and quality of services in this University	.376	.452	.320

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

Relationships at the workplace are a major source of stress among workers in the public universities. When the relationship of an employee with their peers as well as their supervisors is not effective, the employees tend to be under stress in delivering of their duties hence performing poorly. However it is not only the relationship among individuals that might lead to stress within the public organisations. Some other sources of stress include relationships between groups, the public universities, departments or campuses. Stress can emanate from these relationships and transfer to the workers.

Relationships stress arises from conflicts that exist within relationships. Workers will more likely experience more negative moods on the days when they had distressing interactions with those they relate (superiors and co-workers) impacting negatively on their performance. According to the results of the study, most workers in the public universities rarely experience relationship stress. Based on the results, there exists a good relationship between the workers/colleagues at place of work/office (78%) and there is support within the work place in case of a problem. The concerns of the employees are addressed and acted upon promptly (63%). Additionally, the public university administrations are generally supportive especially on issues relating to the welfare of their workers (78%).

Conclusively, Most of the study respondents reported existence of a good relationship between the workers/ colleagues at their place of work place. On the other hand respondents agreed that their colleagues are supportive in case of a problem at places of work. These results support those of Spector (2002) who observes that interpersonal relationships at work such as conflicts with co-workers or abusive behaviour by supervisors cause stress in the work place.

Respondents were observed to refute staff welfare committee support and follows up on the concerns of the employees. Most of them reported that when issues are forwarded to the welfare section /committee, they are not acted upon promptly. This is could be a source of stress for most of the employees. These findings support those of Repetti (1993) who postulates that poor relationship between the superior and the workers contribute to the level of stress experienced by the workers.

Management in this study refers to how the organization supervisors or leaders assign roles to their subordinates and how effectively those roles are assigned to enhance productivity. Working in a large, hierarchical, bureaucratic organization where employees have little control over their jobs can be very stressful. Additionally, when there is a high concentration of assignments at work: excessive work or work that is outside one's capability, employees gets stressed and perform poorly. Since in management supervisors hold each employee accountable to their actions and duties, and for the quality of work they produce, role conflict that relates with mismatched role potentials, and role ambiguity which explains the uncertainty of what is expected, leads to stress and eventually interferes with the performance of the university workers. Respondents were neutral on the statement of whether they were not depressed at work and therefore can perform their duties effectively.

Respondents did not also know how to rate whether they felt always lazy, bored and headache lowering their output. Most of the respondents felt that they did not do the best possible job. However, most of the respondents enjoy their work and are committed to it.

Keeping in view the important role of university workers in ensuring that the institution achieves its objectives of sustaining economic and social development of the country, the concept of university workers performance has achieved a strategic significance. The performance of university workers is affected by intra as well as extra organizational factors, which act as impediments to normal routine functioning of the workers. Once the routine functioning of the workers is disrupted, then the university workers develop feelings of exhaustion and frustration, and if the disrupted situation persists then negative dysfunctional feelings hit the workers which can be termed as stress, which is a reaction to the unwanted environmental stressors.

Workers under stress cannot perform well. Their job satisfaction and motivation levels are decreased and they show unwanted behaviours like absenteeism, mistakes during work, drugs use and abuse and violence at work. Furthermore they have more health related physical and psychological complaints. The university employees' satisfaction level is also decreased in such way that the university cannot offer quality education to the students. The resultant effect include complaints from parents and other stakeholders on the status of service delivery at the institutions, frequent strikes, dissatisfied employees and poor performance of the universities in general, and eventually overall image of the educational institution gets damaged.

This study and its findings should be viewed as a starting point for more extensive research related to determinant and effects of occupational stress. Research on other variables presumed related, either directly or indirectly to employee performance should be researched on. Whereas this research has relied on quantitative approaches to examine the effects of occupational stress affecting the performance of employees, an in-depth analysis of individual responses can generate useful inductive information and provide a richer understanding of the factors important in predicting occupational stress affecting the performance of employees.

REFERENCES

- [1] Addae H.M., Parbooteah K.P. and Velinor N. (2008), Role stressors and organizational commitment: Public sector employment in St. Lucia, *International Journal of Manpower*, 26(6), 567-582
- [2] Addae H.M., Parbooteah K.P. and Velinor N. (2008), Role stressors and organizational commitment: Public sector employment in St. Lucia, *International Journal of Manpower*, 26(6), 567-582
- [3] Akbar, A. (2011). Faculty Stress at Higher Education: A Study on the Business Schools of Pakistan: *World Academy of Science, Engineering and Technology*, 1082.
- [4] Al-Aameri S. (2003). "Source of job stress for nurses in public hospitals": *Saudi Medical Journal*, 4(11), pp.1183- 1187.
- [5] Alexandros-Stamatios G. A.et al, (2003), "Occupational Stress, Job satisfaction, and health state in male and female junior hospital doctors in Greece", *Journal of Managerial Psychology*, 18(6), pp. 592-621
- [6] Allen et al (2000). "Consequences Associated with Work Family conflict: a review and Agenda for future Research"; *Journal of occupational Health Psychology* vol. 5 Pg. 278-308.

- [7] Arnold B. et al (2007), Job resources boost work engagement, particularly when job demands are high, *Journal of Educational Psychology*, 99(2), 274-284.
- [8] Aryee, S. et al (1998), "Family Response variables and Retention Relevant outcomes among Employed Parents." *Human Relations* vol. 51 Pg. 73-87.
- [9] Bachkirova, T., (2005), Teacher stress and personal values: An exploratory study. *School Psychology International*, 26(3), 340-352.
- [10] Balt, R. & Valcour, M., (2003), "Human Resource Practices as predictors of work family outcomes and Employee Turnover" *Industrial Relations*. Vol. 42 Pg. 189-220.
- [11] Barling, et al (2004), *Handbook of work stress*: New York, USA.
- [12] Barnett, R.C., (2004) "Work hours as a predictor of stress outcomes" paper presented at a conference towards a National Research agenda: University of Maryland.
- [13] Barsky, A., et al (2004), "Modelling Negative Affectivity and job stress: A contingency Approach." *Journal of Organizational Behaviour*, vol. 36, pg. 915-936.
- [14] Bashir, U. (2010), Impact of Stress on Employees Job Performance: A Study on banking Sector of Pakistan; *International Journal of marketing Studies*, Vol. 2, 122.
- [15] Beehr, T. A. (2005), *Psychological Stress in the Workplace*, London and New York.
- [16] Betoret T., (2006) Stressors, self-efficacy, coping resources and burnout among secondary school teachers in Spain, *Educational Psychology*, 26(4), 519-539.
- [17] Blomme, R.J., et al (2010), Work-family conflict as a cause for turnover intentions in the hospitality industry: *Tourism and Hospitality Research*, 10(4), 269-285.
- [18] Bloona, R., (2007), *Coping with stress in a changing world*: New York McGraw – Hill.
- [19] Botha C & Pienaar J., (2006), South African correctional official occupational stress: the role of psychological strengths: *Journal of Criminal Justice*. 34(1): 73-84.
- [20] Bradley j. (2007) Job tenure as a moderator of stressor-strain relations: A comparison of experienced and new-start teachers, *Work and Stress*, 21(1), 48-64.
- [21] Brown, Z. A., & Uehara, D. L. (2008). Coping with teacher stress: A research synthesis for Pacific education. www.prel.org: Accessed on 5th December 2013.
- [22] Brown, Z. A., & Uehara, D. L. (2008). Coping with teacher stress: A research synthesis for Pacific education. <http://www.prel.org>
- [23] Cannon, and Walter, B., (1929) *War conflict: Double Rainbow*. Inc Data Render time: 623.
- [24] Caulfield, N., et al (2004) A reviews of occupational stress interventions in Australia: *International Journal of stress management* vol. 11 pg. 149-166.
- [25] Certo S.C. (2003), *Supervision: Concepts and skill building*, New York, NY: McGraw Hill
- [26] Chan H (2003), Hardiness and its role in the stress-burnout relationship among prospective Chinese teachers in Hong Kong, *Teaching and Teacher Education*, 19(4) , 381-395.
- [27] Chang, K., & Lu, L., (2007), Characteristics of organizational culture, stressors and wellbeing: The case of Taiwanese organizations: *Journal of Managerial Psychology*, 22, 549-568.
- [28] Chang, K., & Lu, L., (2007), Characteristics of organizational culture, stressors and wellbeing: The case of Taiwanese organizations: *Journal of Managerial Psychology*, 22, 549-568.
- [29] Chaudhry, A. Q. (2012). An Analysis of Relationship between Occupational Stress and performance. *Bulletin of Education and Research*, 13.
- [30] Cherry, N. M., et al. (2006), "Reported incidence and precipitating factors of work-related stress and mental ill-health in the United Kingdom (1996-2001)": *Occup Med (Lond)* 56(6): 414-421.
- [31] Cohen, S. and Williamson, G.M., (1991), Stress and infectious diseases in humans: *Psychology Bull* vol. 109 p 5-24.
- [32] Coleman, V., (1998) *Stress management Techniques managing for Healthy profits*. London: Cox T. 1980 stress, Maryland University park press.
- [33] Cox, T., Griffiths, A. & Rial-Gonzalez, E. (2000), *Research on Work-Related Stress*, Office for Official Publications of the European Communities: Luxembourg.
- [34] Dar L., Akmal A., Naseem A.M. and Khan K.U. (2011), Impact of stress on employee job performance in business sector of Pakistan, *Global Journal of Management and Business Research*, 11(6), 1-4
- [35] Deaconu, G., (2011), "Stress management strategies for organizations." *Psychology Review*, July.
- [36] Dua, J., (1994), "Job stress and their effects on physical Health, Emotional Health and Job Satisfaction": *Journal of Education and Administration*. Vol. 32, pg. 59-78.
- [37] Falkum, E. et al (1997), Revisiting the factor structure of the ways of coping checklist: a three-dimensional view of the problem-focused coping scale: A study among Norwegian physicians; *Personality and Individual Differences*, 22, 257-267.
- [38] Folkman, S. et al (1986), Appraisal, Coping, Health Status, & Psychological Symptoms, *Journal of Personality and Social Psychology*, 50, 571-579.
- [39] Friedman, M., and Roseman, R., (1974), "Type A Behaviour and Your Heart." Greenwich: Fawcett publications.
- [40] Giga, S., (2011), *The Implied Employment Relationship: Investigating the effects of psychological contract violations on Employee Wellbeing*: Doctoral Thesis University of Manchester Institute of science and Technology, Manchester.
- [41] Glenn, D. I., (2012), "Determining Sample Size, PEO6." University of Florida; IFAS Extension: Obtained from <http://edis.ifas.ufl.edu>.
- [42] Greenberg, J., and Baron, R., (2007) "Behaviour in organizations." New York: Prentice Hall.
- [43] Guglielmi, R., & Tatrow, K. (1998), Occupational stress, burnout, and health in teachers: A methodological and theoretical analysis. *Review of Educational Research*, 68(1), 61-99.
- [44] Hackman, J. R., & Oldham, G. R. (1980). *Work Redesign*, Reading, MA: Addison-Wesley.
- [45] HavLovic, J. & Keenan, P., (1991), "Coping with stress: The influence of Individual Characteristics" ; *Journal of Social Behaviour*. Vol. 6, pg. 25-51.
- [46] He, N. et al (2005), Do race and gender matter in police stress: A preliminary assessment of the interactive effects: *Journal of Criminal Justice*. 33(6): 533-47.
- [47] IvaneRich, J. et al (2006), "Organization Behaviour and Management": New York; Mc. Graw Hill.
- [48] Jayashree, N., (2008), "Factors influencing stress and coping strategies among the Degree College Teachers of Dharwad City, Karnataka": Unpublished Msc thesis, University of Agricultural Sciences, Dharwad.
- [49] John, J., (2009), Hedrich Centre for workforce Development, "Work and Family Pressures Undercutting": *Journal of Technology and Education in Nigeria*. Vol. 12(2) pg. 9-18.
- [50] Judge Sharon, (2003), "Determinants of parental stress in Families Adopting Children from Eastern Europe": *National council on Family Relations*. Vol. 52 (3) pg. 241-248.
- [51] Kaplan, H.G., et al (2004), "Efficacy and Safety of different doses": *Journal of Cannabis Therapeutics* (2001-2004).
- [52] Karasek, R., et al., (1981), "Job decision latitude, job demands and cardiovascular disease: a prospective study of Swedish men": *American journal of public health*, (71) pg. 694-705.
- [53] Karatepe, O.M. et al (2012), Affectivity and organizational politics as antecedents of burnout among frontline hotel employees: *International Journal of Hospitality Management*, 31(1), 66-75.
- [54] Khanka, S.S., (2007) "Corporate Behaviour." New Delhi, Chand and company Limited.
- [55] Kolt G. (2003), Eustress, distress, and interpretation in occupational stress, *Journal of Managerial Psychology*, 18(7), 726-744
- [56] Kompier, M., (2003), Job Design and Well-being: In M. Schabracq, J. Winnubst & C.L. Cooper, (Eds.), *Handbook of Work and Health Psychology*, 429-454.
- [57] Konirigield, et al (2004), "Work Related Stress": European Foundation for Improvement. www.eurofound.europa.eu/...rts/TN0502TRO1/TNO502TR.
- [58] Kreitner, R., Kinicki, A., (2007), "Organizational Behaviour." Mc. Graw Hill.
- [59] Kumar, I. A. (2013), Occupational Stress among Male and Female Elementary School Teachers of District Pulwama: *International Journal of Scientific & Engineering Research*, 940.

- [60] Kumar, R., (2005) *Research Methodology-A Step-by-Step Guide for Beginners*, Pearson Education, 2nd ed, Singapore.
- [61] Landa, J. M.A. et al (2008), The relationship between emotional intelligence, occupational stress and health nurses: a questionnaire survey; *International Journal of Nursing Studies*. 45(6): 888-901.
- [62] Larson, L. L. (2004). Internal auditors and job stress. *Managerial Auditing Journal*, 19, 1119-1130.
- [63] Larson, L. L. (2004). Internal auditors and job stress. *Managerial Auditing Journal*, 19, 1119-1130.
- [64] Larson, L. L. (2004). Internal auditors and job stress. *Managerial Auditing Journal*, 19, 1119-1130.
- [65] Le Fevre M., Matheny J. and Kolt G. (2003), Eustress, distress, and interpretation in occupational stress, *Journal of Managerial Psychology*, 18(7), 726-744
- [66] Le Fevre M., Matheny J. and Kolt G. (2003), Eustress, distress, and interpretation in occupational stress, *Journal of Managerial Psychology*, 18(7), 726-744
- [67] Lee, David, (2009) *Managing Employee Stress and Safety*, Brochure: Author Memic.
- [68] Lind, S.L., and Otte, F.L., (1994) Management styles mediating variables and stress among HRD professionals, *Human Resource Development*. Winter: pg. 301.
- [69] Lu CQ, et al (2005), Managers' occupational stress in China: the role of self-efficacy: *Personality and Individual Differences*. 38(3):569-78.
- [70] Luthan, F., (2008), *Organizational Behaviour*: New York: Mc. Graw Hill.
- [71] Mairura, L., (2009), "counselling for Teenagers with chronic stress: A case of students in Nairobi Day Schools." Nairobi, Kenya
- [72] Margets, E.L., (1975), "Stress, Homeostasis and the Human Ecological continuum": *Journal of Society, Stress and Distress*. vol. 2. Pg. 22-36.
- [73] Mark, G.M. & Smith, A. P. (2008), The relationship between workplace stress and job characteristics, individual differences, and mental health.
- [74] Mc. Gart, J., (1976), *Social and Psychological Factors in Stress*. New York: Holt and Rinchart.
- [75] Mc. Hugh, M., (1997) "The stress factor: another Item for change management Agenda." *Journal of Organizational change* vol. 10 pg. 345-362.
- [76] Mc. Shane, S., Von. Glinow, and Sharma, R., (2008) *Organizational behaviour*. New Delhi: Mc. Graw.
- [77] Miller, L., (2009) *Stress Causes Rigidity* (PhD). The Business case for stress management – 4 imprint .Info.4imprint.com/...t/uploads/M0709-02 blue-papers.
- [78] Mohammadi Z. et al. (2013), Evaluation of relationship occupational stress with shift work in the agency drivers in Yazd: *Occupational Medicine*, Vol. 6, No. 3
- [79] Mohanraj, P. & Manivannan, L., (2013), Occupational stress among migrated workers in unorganised sectors : IRACST- International Journal of Research in Management & Technology (IJRMT. Vol. 3, No.1.
- [80] Mojinyinola, J. K. (2008), Effects of Job Stress on Health, Personal and Work Behaviour of Nurses in Public Hospitals in Ibadan Metropolis, Nigeria: *Journal of Social Work* , 143-148.
- [81] Munali, J., (2005), "Stress and Individual Performance of workers in Hotels at the Kenyan coast": Unpublished M.A. thesis, Cornell University USA.
- [82] Musyoka, M. et al (2012), Employee stress and performance of companies listed in the Nairobi securities exchange: *DBA Africa Management Review* 2012, vol.3. No. 1 pp 115-129.
- [83] Naituli, B.K., (2008), "Leadership practices and the influence of stress: A study of Kenyan managers": Unpublished thesis, Egerton University.
- [84] Nakata, A., M. Takahashi, et al. (2008). "Perceived psychosocial job stress and sleep bruxism among male and female workers." *Community Dent Oral Epidemiol* 36(3): 201-209
- [85] National Occupational Health and Safety Commission (2003), 'Compendium of workers' compensation statistics, Australia, 2000-2001: Canberra, Australia. NEL MH, (2004)
- [86] New Stroom, J., (2007) *organization behaviour: human behaviour at work*. New Delhi: Mc. Graw Hill.
- [87] Ng'ethe, J.M. (2012), Determinants of Academic Staff Retention in Public Universities in Kenya: *Empirical Review*. *International Journal of Humanities and Social Science* Vol. 2 No. 13
- [88] Ngeno, G., (2007) "Causes of Burnout among primary school Teachers within Kericho municipality, Kenya."
- [89] Ngome, C.K. (2010) Massive Growth of University Education in East Africa and the Challenges facing the Sector from 2000 to 2011: The case of Kenya, IUCEA conference, 19th-21st October, 2010, Kampala, Uganda.
- [90] Nilufar, et al (2009) International conference on Business and Economic Research, Academic report has been reported all over the world.
- [91] NIMH (2013), Stress for Adults: How it affects your health and what you can do about it. Available at: http://www.nimh.nih.gov/health/publications/stress/Stress_Factsheet_LN_142898.pdf
- [92] Noblet, A., (2003) "Building Health promoting work settings: Identifying the relationship between work characteristics and occupational stress in Australia" *Health Promotion International*. Vol.18 (4) pg.351-359.
- [93] Obwogi, J. (2011), Factors that affect Quality of Teaching Staff in Universities in Kenya. PhD Thesis, Jomo Kenyatta University of Agriculture and Technology
- [94] Olali, B., (2005), "Stress and Individual Performance: A case of Kaimosi Teachers College" Unpublished M.A.; Thesis Moi University, Kenya.
- [95] Owino, G. et al (2011), Role of institutional managers in quality assurance: reflections on Kenya's University education: *Australian Journal of Business and Management Research*. Vol.1 No.2
- [96] Pabla, D. M. (2012), Occupational Stress Amongst Teachers of Professional Colleges in Punjab: *Indian Journal of Research*, 112.
- [97] Park, C.L. & Folkman, S. (1997), Meaning in the context of stress and coping, *Review of General Psychology*, 2, 115-144.
- [98] Park, C.L. & Folkman, S. (1997), Meaning in the context of stress and coping, *Review of General Psychology*, 2, 115-144.
- [99] Perrewe, P.L., & Zellars, K.L. (1999), An examination of attributions and emotions in the transactional approach to the organizational stress process: *Journal of Organizational Behaviour*, 20, 739-752.
- [100] Pestonjee, D.M., (1992), *Stress and Coping* .Sage publications New Delhi.
- [101] Pierce J., & Delahaye, B., (1996), Human Resource management implications of dual-career couples .*International Journal of Human Resource management* (v7) pg. 905-923.
- [102] Porter, and Steers, (1987), Effects on role loss on work-related attitudes. *Journal of Applied Psychology* vol. 72(2) pg. 287-293.
- [103] Ramzan, M., (2012), A Study on Understanding the Factors Contributing To Teachers' Professional Stress in the Private Schools of Gilgit-Baltistan. *Strength for Today and Bright Hope for Tomorrow*, 349
- [104] Repeth, R.L (1993), "The effect of workload and Sonal Environment on Healthin L. Goldberger and S. Breznitz (Ed). *Handbook of stress: Theoretical and Clinical Aspects*. pp 120-130
- [105] Robbins S. et al (2009), *Organization and stress management*: New Delhi, India; Dorling Kindersley
- [106] Robbins, and Judge, (2007), *Organizational behaviour*: New Jersey; Pearson Education.
- [107] Robbins, S., (2003), *Organizational behaviour*: New Jersey; Pearson Education. Rutgers University.
- [108] Robert, J. C., (2002) *Types of Research Design: Analyzing, Interpreting & Using Educational Research*. Resources for the Ed. D. unit, Research Methods, 2002 found at www.dur.ac.uk/r.j.coe/resmeths/types.doc.
- [109] Rosania, A. E., K. G. Low, et al. (2009). "Stress, depression, cortisol, and periodontal disease": *J Periodontol* 80(2): 260-266.
- [110] Santos, J. R. A., (1999) Cronbach Alpha: A Tool for Assessing the Reliability of Scales. Available at <http://www.joe.org/joe/1999april/tt3.html>.
- [111] Sayeed, O.M., (2001), *organizational commitment and conflict*. New Delhi: Sage publication.
- [112] Selye, H., (1956) *Stress of Life*. McGraw Hill: New York.
- [113] Spector, P.E., (2002), "Employee Control and Occupational Stress": Sage publications, vol.11 (4) pg. 133-136.
- [114] Sultana, B. (2012), The Nature and Impact of Teacher Stress in the Private Schools of Gilgit-Baltistan, Pakistan: *International Journal of Academic Research in Progressive Education and Development*, 82, 83.

[115] Sveinsdottir, H., et al (2006). Occupational stress, job satisfaction, and working environment among Icelandic nurses: a cross-sectional questionnaire survey: *International Journal of Nursing Studies*. 43(7): 875-89.

[116] Tetley, J.W. (2009), Deficits in Academic Staff Capacity in Africa and Challenges of Developing and retaining the next Generation Academics: Partnership for Higher Education in Africa.

[117] Trice, H.M. & Sonnenstuhl, W.J., (2010), "The construction of drinking norms in work organizations": *Journal of studies on Alcohol* vol. 51, pg. 201-220.

[118] Vakola, M., & Nikolaou, I. (2005), Attitudes towards organizational change: What is the role of employees' stress and commitment? *Employee Relations*, 27, 160-174.

[119] Vitaliano, P.P. et al (1985), The Ways of Coping Checklist Psychometric Properties, *Multivariate Behavioural Research*, 20, 3-26.

[120] Warr, P., (1990), The Measurement of Well-being and Other Aspects of Mental Health.: *Journal of occupational psychology*. (v.52) pg. 129-148.

[121] Waswa F. & Swaleh S. (2012), Faculty opinions on emerging corporatization in public Universities in Kenya. *Education and General Studies* Vol. 1(1) pp. 009-015

[122] Webster, T., & Bergman, B., (2009), Two international conferences on management 969 (21CM 2012): Occupational stress: counts and rates compensation and working conditions. Washington, USA.

[123] Welford, A., (1973), "Stress and performance": *Ergonomic*, vol. 16 pg.567.

[124] West, H., & Mackay, J., (1999), "Employment Roles and Counsellors in Employee Assistance Programmes": *Journal of counselling psychology*. Vol.7 pg. 355-389.

[125] White E. (2006), Opportunity knocks and it pays a lot better, *The Wall Street Journal*, 13

[126] Wilson, B., (2007) *Wilson Heart care, Heart Math and Cardiologist...* publications in January 2007(PhD). www.wilsonheartcare.com/bio 2.html

[127] Workplace Relations Ministers' Council (2003) Comparative performance monitoring, fifth report, 'Australia and New Zealand Occupational Health and Safety and workers' compensation schemes,' Canberra.

[128] Worrall, L., & Cooper, C., (1999), *Quality of working life survey*: Institute of Management, London.

[129] Yagil, D., (1998). If anything can go wrong, it will: occupational stress among inexperienced teachers: *International journal of stress management*. (v5) pg. 179-188.

[130] Yamane, Y., (1976) *Statistics: An introductory Analysis*, 2nd Ed. New York: Harper and Row.

[131] Yambo, J.M.O. et al (2012), Investigating High Schools Principals Stress in Relation to their job experience in schools in Southern Nyanza Region of Kenya: *International Journal of Academic Research in Progressive Education and Development*, vol. 1, No. 4 ISSN 2226-6348.

[132] Zhimin, L. & Ramani K., (2012), A study on the conflict resolution mechanisms in higher educational institutions: A case of Kenya's public universities. *Educational Research Journals* Vol. 2(6), pp. 208-216.

AUTHORS

First Author – John Ng'ang'a Karihe, Doctor of philosophy in Human Resources Management of Jomo Kenyatta University of Agriculture and Technology
Second Author – Professor G. S. Namusonge, Supervisor, Jomo Kenyatta University of Agriculture and Technology
Third Author – Dr. Mike Iravo, Supervisor, Jomo Kenyatta University of Agriculture and Technology

APPENDIX 3: TABLES

Table 4.14: Correlations for Employee Performance

	Statistic	g1	g2	g3	g4	g5	g6	g7	g8	g9	g10	g11	g12	g13
g1	Pearson Correlation	1	.009	.012	-.080	.069	.033	-.067	-.019	-.011	-.060	-.037	-.033	-.098
	Sig. (2-tailed)		.871	.833	.153	.205	.544	.217	.726	.845	.273	.498	.541	.075
g2	Pearson Correlation	.009	1	-.025	-.070	.110	.176**	.286**	.141*	-.188**	.265**	-.147**	-.074	.139*
	Sig. (2-tailed)	.871		.658	.229	.053	.002	.000	.013	.001	.000	.009	.197	.016
g3	Pearson Correlation	.012	-.025	1	.104	-.037	-.025	.030	-.016	.028	-.008	-.075	-.059	-.006
	Sig. (2-tailed)	.833	.658		.064	.502	.645	.582	.776	.618	.881	.172	.284	.920
g4	Pearson Correlation	-.080	-.070	.104	1	.076	-.113*	.248**	.040	.261**	.309**	-.261**	-.121*	-.061
	Sig. (2-tailed)	.153	.229	.064		.169	.041	.000	.473	.000	.000	.000	.028	.278
g5	Pearson Correlation	.069	.110	-.037	.076	1	.022	-.121*	.015	-.157**	.136*	.151**	.277**	-.063
	Sig. (2-tailed)	.205	.053	.502	.169		.682	.025	.778	.004	.011	.005	.000	.249
g6	Pearson Correlation	.033	.176**	-.025	-.113*	.022	1	-.155**	.117*	.081	.068	-.273**	-.358**	-.209**
	Sig. (2-tailed)	.544	.002	.645	.041	.682		.004	.030	.134	.212	.000	.000	.000
g7	Pearson Correlation	-.067	.286**	.030	.248**	-.121*	-.155**	1	.162**	.211**	.462**	-.214**	-.140**	.228**
	Sig. (2-tailed)	.217	.000	.582	.000	.025	.004		.003	.000	.000	.000	.009	.000

g8	Pearson Correlation	-.019	.141*	-.016	.040	.015	.117*	.162**	1	.118*	.312**	.022	-.005	.237**
	Sig. (2-tailed)	.726	.013	.776	.473	.778	.030	.003		.028	.000	.688	.933	.000
g9	Pearson Correlation	-.011	-.188**	.028	.261**	-.157**	.081	.211**	.118*	1	.176**	-.070	-.026	-.048
	Sig. (2-tailed)	.845	.001	.618	.000	.004	.134	.000	.028		.001	.194	.637	.382
g10	Pearson Correlation	-.060	.265**	-.008	.309**	.136*	.068	.462**	.312**	.176**	1	.101	.107*	.345**
	Sig. (2-tailed)	.273	.000	.881	.000	.011	.212	.000	.000	.001		.061	.049	.000
g11	Pearson Correlation	-.037	-.147**	-.075	-.261**	.151**	-.273**	-.214**	.022	-.070	.101	1	.693**	.192**
	Sig. (2-tailed)	.498	.009	.172	.000	.005	.000	.000	.688	.194	.061		.000	.000
g12	Pearson Correlation	-.033	-.074	-.059	-.121*	.277**	-.358**	-.140**	-.005	-.026	.107*	.693**	1	.218**
	Sig. (2-tailed)	.541	.197	.284	.028	.000	.000	.009	.933	.637	.049	.000		.000
g13	Pearson Correlation	-.098	.139*	-.006	-.061	-.063	-.209**	.228**	.237**	-.048	.345**	.192**	.218**	1
	Sig. (2-tailed)													

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Effects of Working Facilities Stress Factors on the Performance of Employees in Public Universities in Kenya

John Ng'ang'a Karihe¹, Professor G. S. Namusonge², Dr. Mike Iravo³

¹Doctor of philosophy in Human Resources Management of Jomo Kenyatta University of Agriculture and Technology

²Supervisor, Jomo Kenyatta University of Agriculture and Technology

³Supervisor, Jomo Kenyatta University of Agriculture and Technology

Abstract- The aim of this study was to assess the effects of occupational stress and how it affects employee performance in the public universities in Kenya. Specifically the study seeks to determine the effect of working facilities stress factors on the performance of employees in public universities in Kenya. The study employed a cross-sectional evaluation survey approach. This used both qualitative and quantitative methods in the selection of the participants and collection of data. Cluster sampling was employed to select 384 respondents. Data collection instruments included interviews, questionnaires and document reviews. The collected data was captured in MS Excel and analyzed using SPSS version 24 (Statistical Package for Social Scientists). Linear regression analysis and Pearson's correlation coefficient were run to determine relationship between stress factors and workers performance. The analyzed data was presented in suitable graphs, charts and tables. By correlating the determinants of stress with performance, the study found out that the determinants of stress include movement, motivation, workers relationships, management and working facilities. The study found a significant relationship ($F(3,342) = 57.717, p < 0.05$) between Workplace facilities and employee performance. The nature of the relationship was found to be positive in the sense that unit increase in Worker's relationship, Worker's movement, Workplace facilities and Management leads to an increase in Employee performance as demonstrated by the equation: Employee performance = $2.286 + .115 \text{Workplace facilities} + .096 \text{Management}$

Index Terms- working facilities, stress factors, employee performance

I. INTRODUCTION

Recent trends have also made it increasingly difficult for employees to adequately balance the responsibility of their families, as employees are working longer hours and bringing more work home at night. This has resulted to more pressure being placed on the work-family relationship such that coordination of work, vocation schedules and child care options have become very unsuccessful (Dar et al. 2011). More and more voices warn about the possible risks that could emerge if the human resource management ignores the current signs of increase in levels of stress among employees (Robbins & Judge, 2007). Organisations therefore need to respond to stress

experienced by employees in order to enhance their legitimacy and obtain the resources necessary for their survival.

Stress in University workers is an on-going issue of concern for those involved in education. Numerous studies found that job stress influences the employees' job satisfaction and their overall performance in their work, because most of the organizations now are more demanding for the better job outcomes (McGrath et al., 2003). Academic staff has a major role to play in achieving the objectives of the institution (Kumar, 2013). The performance of the staff; teaching, non-teaching teachers and also as managers, determines to a large extent, the quality of the student experience in the Universities and has a significant impact on student learning and thereby on the contribution that such institutions can make to the society (Kumar, 2013). Stress of University workers therefore needs to be addressed.

Mojoyinola (2008) contend that coping can function to change the situation out of which stressful experiences originate (Problem-focused), change the meaning of such experiences before the emergence of stress (perception-focused), and control the emotional reaction to stress after it has emerged (emotion-focused). If one is suffering from stress, the aspect of life that causes it has to be identified. These aspects will then help in developing strategies to deal with stress. According to Dar, Akmal, Naseem and Khan (2011) steps such as changes in lifestyle or other small strategies can help to deal with stress. The work can be delegated or shared and avoid confrontation with problematic colleagues. Learning to be assertive, taking regular exercise, avoiding alcohol and drugs can reduce stress. On the other hand, eating a healthy, balanced diet rich in fruits and vegetables, finding humour in stressful situations, time management, talking to friends or family and sharing thoughts and fears can fight stress.

Workers in the Universities have often found themselves in dissatisfactions that have manifested them greatly in the recent past. In November 2011, a major strike was held nationwide in Kenya by all the public universities workers. This led to the closure of several universities. This strike among other things affected learning, examinations and graduation programmes. Concurrently there was a go slow in Brazil in October and November by dissatisfied university lecturers. It is with this background that the researcher seeks to carry out a study in selected universities in Kenya to establish the effects of occupational stress on employees' performance and provide

practical coping strategies that can be employed to reduce or completely alleviate stress in public universities.

According to Waswa and Swaleh (2012) minimal attention has been given towards ensuring workers in public universities have been provided with the necessary resources, motivation, effective job allocation measures and management to avert continuous strikes that have lowered the standards of education in the country. Additionally Owino et al (2013) argues that lack of resources, motivation, poor leadership and negative relationships leads to stressed employees and poor performance. Zhimin and Ramani (2012) advises that stress factors should be met to enhance conflict resolution within Kenya's public universities. This study therefore seeks to assess the determinants of occupational stress in public universities and their contribution to the performance of workers.

The information from this study may form part of policy making for both the government and the management of public universities. The information on the stress factors affecting the performance of workers in public universities may be used by the management of the public universities in developing strategies and providing an environment that will ensure improved productivity of the workers.

Through this study on the stress factors affecting the performance of workers in public universities, the general public and the management of the universities as well as the workers themselves will be able to understand and appreciate the performance of workers that are exposed to such stressors.

Academicians and researchers who are willing to provide more education and solution to workers stress may use the information from this study to inform their understanding and arguments. Additionally, the information from the study may also form basis for literature for other researchers and academicians who are willing to carry out studies in the same field in sub-Saharan Africa.

The study was carried out within Nairobi County metropolitan. The study therefore focused on public universities that operate within or closer to Nairobi County. Nairobi Metropolitan consists of four regions which cover approximately 32000 square kilometres the four regions are: Core Metro that includes the City of Nairobi; Northern Metro includes the municipal councils of Kiambu, Limuru, Ruiru, Thika, and Karuri, the Town councils of Kikuyu and the County Council of Kiambu; Southern Metro that includes the Town Council of Kajiado and the County Council of Olkejuado; and Eastern Metro that includes the Town Council of Kangundo/ Tala, the Municipal Councils of Machakos and Mavoko and the County of Masaku.

Public universities were selected because their workers have unions or organisations that advocate for a stress free environment for them. The unions (Kenya Universities Staff Union (KUSU) and the Universities Academic Staff Union (UASU)) are responsible for ensuring that there are favourable working conditions for all public university workers. Involving the public universities therefore provided in-depth information on workers stress on performance since they are aware of their stressors at work and are taking steps to address them by forming unions to champion for their rights. Nairobi Metropolitan was chosen as the area of study because all the major public

universities in Kenya are either based or have campuses within Nairobi Metropolitan.

II. LITERATURE REVIEW

2.1.1 Relational theory

In his theory, Lazarus regards stress as a relational concept, that is, stress is not defined as a specific kind of external stimulation or a specific pattern of physiological, behavioural, or a subjective reactions. Instead, stress is reviewed as a relationship between individuals and their environment. Psychological stress involves relationship with the environment that an individual appraises as significant for his or her well-being and in which the demands tax or exceed available coping resources. These definitions points to two processes as central mediators within the person-environment transaction: cognitive appraisal and coping.

This concept is based on the idea that emotional processes (including stress) are dependent on actual expectancies that persons manifest with regard to the significance and outcome of a specific encounter. This concept is necessary to explain individual differences in quality, intensity, and duration of an elicited emotion in environments that are objectively equal for different individuals. The most important factors on the personal side are motivational dispositions, goals, values and generalized expectancies. Relevant situational parameters are predictability, controllability, and imminence of a potentially stressful event.

2.1.2 Homeostasis theory

According to Mojinyinola (2008), the body possesses internal mechanism to maintain a stable bodily functioning or equilibrium. As the environment presents the organism with various challenges, the body must respond to each new situation and by adjusting various physiological systems to compensate for the resources being taxed. A classic example of this type of compensation involves fluid regulation. When an organism ingests a large amount of water, the kidney releases more waste fluid into the bladder for eventual disposal in an effort to maintain bodily equilibrium. Many of the feedback mechanisms that regulate blood pressure presented in the body share similar characteristics with bodily systems that maintain homeostasis. According to Mojinyinola (2008), failure of the body to respond to environmental challenges by maintaining bodily homeostasis results in damage to target organs and eventually death. The concept of homeostasis introduced therefore proves to be very valuable in explaining how acute physiological stress responses to threats of survival would lead toward chronic stress responses.

2.1.3 Welford's performance and demand theory

Welford's performance and demand theory (1973) shares much in common with the theory proposed by Selye (1956). In this theory, stress arises whenever there is a departure from optimum conditions of demand which the person is unable to correct. Organisms including man appear to have evolved so that they function best under conditions of moderate demand. An individual's performance is less than maximum efficiency if they experience either too high or too low level of demand. Margetts (1975) offers a similar approach in terms of stimulus input. Living organisms adjust themselves to maintain a reasonable input of stimuli. If the input of stimuli is excessive or insufficient for the individual organism, the excess or insufficiency can be

considered stressful. The organism's homeostasis is threatened by stress, and if it cannot manage it, it goes into a state of disequilibrium or breakdown. This may be temporary, pending readjustment, or may proceed to a more profound disorder, leading to functional or structural pathology. This theory is credited for using the inverted U when explaining the relationship between demand and performance, which has some biological validity (Nakata et al., 2008). Bloona (2007) argues that just like the response based theory, the Welford performance and demand theory leaves out individual characteristics which explain why people perform differently under the same stressor. Cox and Mackay (1976) proposed a more complex theory, which grew out of the need to systematically understand the transaction between the individual and his environment. The primary focus of this theory is on individual perceptual phenomena rooted in psychological process. They explain the role of cognitive appraisal of potentially stressful situation in determining how one will react. If a situation demands too much of a person but he has not realized his limitation, he will work on without being stressed until it becomes obvious to him that he cannot cope, he then experiences stress. McGrath (1976) further observes that stress arises when there is an imbalance between perceived demand and the perception of his capability to meet the demand. The presence of this perceptual factor allows for operations of a wide variety of organismic variables such as personality which contributes to the existence of individual characteristics. This theory is credited for introducing the individual variation aspect. Since it considers the status of the individual in relation to his environment and also brings in the individual characteristics which are often forgotten in laboratory studies. Critics of this theory argue that it does not account for situations that place psychological demands without the immediate involvement of other more physiological processes (Cox 1980).

2.1.4 Hertzberg's two factor theory

Hertzberg's two factor theory has been used to explain occupational stress. He carried out his now famous survey in 200 accountants and engineers from which he derived his initial framework for his theory (Steers & Porter, 1987). The theory argues that job satisfaction depends on the motivator factors which include variables such as achievement, recognition, the work itself, responsibility advancement and growth. Conversely dissatisfying experiences called hygiene factors resulted largely from extrinsic, no job related factors such as company policies,

salary and supervisory style. Cox (1980) in his studies on stress posits that lack of job satisfaction results to stress and improving the hygiene factors by redesigning and enriching jobs will promote satisfaction. This will in return reduce stress and improve performance. Hertzberg's work is credited for its stimulating thought of introducing motivation at the workplace and therefore giving people a better understanding of job related stress. Critics of this theory argue that it does not give sufficient attention to individual characteristics which are very important in understanding human behaviour (Bloona 2007).

2.1.5 Stress Theory Model

A model is a systematic organization of knowledge on some topic. There are several models developed to provide an insight on stressors and their coping strategies. This study will however major on only two models to explain stressors and one model focusing on stressors and their coping strategies.

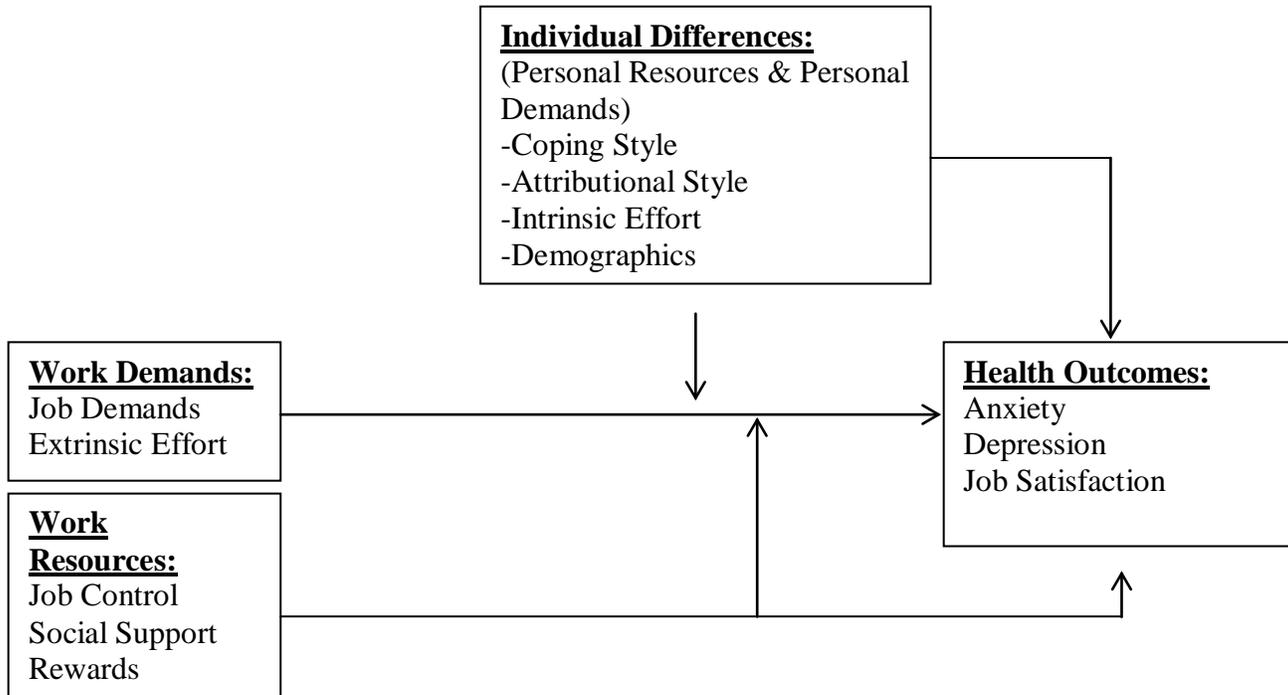
a) Demands, Resources, and Individual Effects model

In light with the literature on stress models, Mark and Smith (2008) suggested the DRIVE model that perhaps elucidates stressors effectively. In this model they acknowledge the important role played by psychosocial workplace stressors in the stress process, and tries to account for the role of important individual difference factors in the development of subjective experiences of stress, and in influencing the possible health-related outcomes that result from subjective stressful perceptions. This framework aims to represent key aspects of the stress process, without getting bogged down in the minutiae of more complex theories and mental processes.

They developed and tested the model shown below which simultaneously compared a number of job characteristics and individual difference variables in the prediction of anxiety, depression, and job satisfaction, in a working population. Independent variables included: job demands, social support, decision authority, and skill discretion; extrinsic effort, intrinsic effort and rewards; 40 coping behaviours which included the categories of problem focused coping, seeking advice, self blame, wishful thinking, and escape/avoidance; attributional/explanatory styles; and age, gender, and demographic variables. This framework was called the Demands, Resources, and Individual Effects model (DRIVE).

Source: Mark and Smith (2008)

Figure 2.1 The DRIVE model



In the model, workplace and individual characteristics are conceived of in terms of work demands and resources, and individual demands and resources. Other work demands and resources could include workload, bullying, job security, management style, feedback etc, and other personal demands and resources could include self efficacy, locus of control, personality, home environment, experience, work/life balance, role conflict, etc.

The model proposes that work demands, individual differences, and work resources are all proposed to have main effect relationships on anxiety, depression, and job satisfaction (other outcomes could include organizational commitment, musculoskeletal disorders, gastro-intestinal disorders, heart disease, absence). It is also proposed that work resources and individual differences may moderate the relationship between work demands and health outcomes. The individual difference variables of positive coping (problem focused coping) and attributional styles can be seen as personal resources, and intrinsic effort, negative coping (self-blame) and attributions as “personal demands”, as maladaptive behaviours are effectively self-induced demands. This model makes no predictions about the “importance” of the different variables in predicting outcomes, and gives each type of variable (work and individual demands and resources) a theoretical equivalency.

b) The cognitive theory of psychological Stress and coping

Lazarus and Folkman’s theory of psychological stress and coping (1980) is perhaps the most theoretically influential transactional theory. Sometimes known as the Cognitive-Relational approach, the individual and their environment are seen as coexisting in a dynamic relationship, where stress is the psychological and emotional state that is internally represented

aspart of a stressful transaction (Folkman, Lazarus, Gruen&DeLongis, 1986).

The two key concepts in this process are appraisal and coping (Cox et al., 2000).Folkman et al (1986) describe primary appraisal as the first stage of the appraisal process, where encounters are subjectively evaluated to see what is at stake in terms of potential risk (Perrewe&Zellars, 1999) and these assessments allow for the influence of individual differences, because the nature of what is considered stressful is individual-specific (Park &Folkman, 1997).

In later work, Park and Folkman (1997) write that the attribution of meaning that individuals give to events, can be framed by existing beliefs based on their global meaning. These are enduring beliefs and valued goals, based on fundamental assumptions, theories of reality (e.g. religion), self-worth, life experience etc. Park and Folkman (1997) propose that the making of situational meaning is what occurs when an individual’s global beliefs and goals interact with the specifics of a particular person-environment transaction which are defined by the processes of appraisal and coping.

If a situation is evaluated as potentially stressful, then secondary appraisal occurs, which is where the individual evaluates if the potential harm can be altered, avoided or prevented (Park &Folkman, 1997), where to assign blame or credit, and what future expectations are. Potential actions or ways of coping are assessed, informed by past coping experience, personality, personal resources (and presumably global meaning). Folkman and Lazarus (1980) described many types of coping behaviours, and suggested that they could be aggregated into two major categories of coping response: problem-focused coping (attempts to cope using more rational problem solving type approaches) or emotion-focused coping

(emotional-oriented coping approaches) each of which are suitable in different kinds of situation.

While the problem focused/emotion focused distinction has been popular in research, many argue that it is important to split coping into more distinct categories (many based on Folkman and Lazarus' work) such as problem focused coping, seeking social support, blamed self, wishful thinking, and avoidance (Vitaliano, Russo, Carr, Maiuro & Becker, 1985) and action oriented coping, accommodation, positive thinking, seeking support, self-blame and defence (Falkum, Olf & Aasland, 1997). Once possible coping methods are assessed and selected, then the final stage of the model occurs, where coping is implemented. Coping has been characterized as (Folkman et al, 1986) "cognitive and behavioural efforts to manage (reduce, minimise, master, or tolerate) the internal and external demands of the person-environment transaction that is appraised as taxing or exceeding the person's resources". Robbins, Judge and Sanghi (2009), suggest that coping is the main method by which incongruence between global meaning and situational meaning is managed. A failure to cope successfully (from excessive demands or lack of resources) is likely to lead to stress and negative health and organizational outcomes (Chaudhry, 2012).

2.2 Empirical Studies carried on causes and effects of Stress

The literature indicates that there is a relationship between age, gender, marital status, educational level, position, length of service and working experience with occupational stress (Landa et al. 2008; Lu, Siu & Cooper, 2005) but the results of a study that was conducted on urban police officers in the USA, showed that dynamic factors such as work environment and coping mechanisms, contributed more to explain variance of police stress than static factors such as race and gender (He, Zhao & Ren, 2005). In several studies income, heavy workload, lack of workspace, lack of resources (including equipment and material to do tasks), absence of proper company procedures, insufficient time to perform duties, meeting deadlines imposed by others, have been introduced as stressors related to work environment (Botha & Pienaar, 2006). In other studies external accountability, responsibility, work relationships, insufficient consultation, communication, inadequate feedback on performance and organizational changes have been introduced as sources of occupational stress (Sveinsdottir, Biering & Alfons, 2006).

According to Beehr, (2005) work overloads and time constraints were significant contributors to work stress among community nurses. Workload stress can be defined as reluctance to come to work and a feeling of constant pressure (i.e. no effort is enough) accompanied by the general physiological, psychological, and behavioural stress symptoms (Larson, 2004). Al-Aameri (2003) has mentioned in his studies that one of the six causes of occupational stress is pressure originating from workload. Alexandros-Stamatios, et al. (2003) also argued that "factors intrinsic to the job" means workload, variety of tasks and rates of pay.

Grzywacz (2004) conducted a research on stress and education level among 1031 workers. He found out that less educated people suffer few stressful days but when they suffer stress it's more severe and had a large impact on their health. Combs (2004) on the other hand, conducted a research on marital

status and stress among 300 workers and found that married couples reported more stress than their single counter parts.

Karatepe et al (2012) conducted a research on role stress, emotional exhaustion and turnover on frontline hotel employees in Cyprus. The results showed that the positive effect of role conflict and emotional exhaustion on turnover intentions was weaker among the frontline employees with longer tenure. Cavanaugh et al (2010) also conducted a research on role conflict and personality among managers. They found that individuals with type B personality managed conflict better and were better off at managing large organizations.

Philips Campbell and Morrison (2010) conducted a research on satisfaction, stress and spousal support among 242 married veterans. Both genders reported that income and time required for work was the greatest dissatisfaction. Males reported more spousal support on their careers. They proposed a study on the interactive effect among combination of stressors that are commonly found in the world of work. No differences were found between the genders on the effect of work related stress.

Sultana (2012) carried out a study on the nature and impact of teacher stress in the private schools of Gilgit-Baltistan in Pakistan. Analysis of the findings of the study resulted in categorizing them into three groups: personal stress, professional stress and financial stress. However, the impact of each one of the three groups of teacher stress (i.e. personal, professional and financial) was different for different teachers. It looked like some teachers felt more stressed because of a variety of personal and domestic factors, whereas other teachers felt more constrained because of financial issues. Furthermore, the data analysis also highlighted the sources of teacher stress, which could be easily identified as the "inside-school" and the "outside-school" sources of stress. The various findings related to each one of the two categories are revealing as they show the significance and degree of enormity of stress factors related to these groups.

Blomme, Rheede and Tromp (2010) conducted a research on work life programmes and firm productivity among 658 US organizations. It was fully established that organizations that had extensive work life programmes enjoyed productivity benefits. They suggested further research that takes into accounts other organizational variables such as job satisfaction and organizational commitment.

Deaconu (2011) conducted a research on stress management and performance among 180 sales people. He established that Bio feedback and counselling enhanced performance of sales personnel.

Barnett (2004) conducted a research on work hours and stress outcomes among 211 dual income earner couples with children. He found that long hours of work had an effect on marital quality, psychological distress and work-family conflict. He proposed further research on the linkages both individually and within couples between long working hours and health behaviours such as regular exercises, routine medical checkups and healthy eating.

In Kenya a lot of research on causes of workers stress in educational institutions had focused on teachers. Gathungu and Wachira (2013) carried out a study on the job satisfaction factors that influence the performance of secondary school principals in their administrative functions in Mombasa district, Kenya. They found out that the determinants of stress include job satisfaction,

job enhancement, team work, promotion, cooperation, mentoring and training needs, the development, management and recognition of success.

Yambo, et al. (2012) focused on investigating high school principals' stress in relation to their job experience in schools in Southern Nyanza Region of Kenya. They found out that the sources of stress: Role Based, Task Based, Conflict Mediating and Boundary Spanning had a correlation and dependable relationship with High School Principals' job Experience in schools.

Mairura (2009) conducted a research on counselling, self-esteem and stress among 130 teenagers in Nairobi day schools. He found that counselling was effective in managing stress experienced by teenagers and raised their self-esteem. He suggested further research on the same area, expanding the approach to include a larger or more representative sample.

Obwogi (2011) conducted a research on the factors that affect quality of teaching staff in universities in Kenya supplementing Ngoma's research in 2010 on the massive growth of university education in East Africa and the challenges facing the sector from 2000 to 2011. From both studies it's clear that something is not right among the university workers and something needs to be urgently done even as the work load increases in the public universities.

In response to the issue of universities workers problems, Muceke (2012) observed that most of the studies on academic staff retention were based on the corporate sector. There was only one from the public universities done by Tettey in 2009. Muceke (2012) noted the problem of academic staff retention in Kenyan public universities is a pertinent issue and it is expected to be worse with the double intake in 2011/2012 academic year.

Musyoka et al (2013) in their research on the role of stress management in reducing stress and enhancing corporate performance concluded that the Government of Kenya is responsible for all workers through the ministry of labour. It has the duty to set regulations on minimum pay, health and safety of workers among others. They suggest that FKE and COTU should come-up with regulations that will prevent or manage stress. They further suggest that Human Resources Manager who works in these corporations must be able to handle traumatic incidents, mediate conflict situations at work and organize for drug-alcohol abuse programmes for the staff. Getting in touch with employees brings the important aspect of social support which helps employees improve their perception and realize that they are valued, and in turn enhances their self-esteem and confidence at the work place. This translates to higher job performance among employees and is reflected by improvement of the measures of corporate performance such as customer satisfaction, employee creativity, productivity, higher market share and profitability. Critical to organizations supportive culture is sensitizing supervisors to be sympathetic to employees desire to seek balance between work and family needs. Finally managers should organize seminars for employees to educate them on time management, financial management, team work enhancing programmes and healthy living seminars in order to manage their own stress.

III. RESEARCH METHODOLOGY

This study adopted both exploratory and descriptive. Creswell (2014) argues that a flexible research design which provides opportunity for considering many different aspects of a problem is considered if the purpose of the research study is that of exploration. When the purpose happens to be an accurate description of a situation or of an association between variables, the suitable design will be one that minimizes bias and maximizes the reliability of the data collected and analyzed (Kothari, 2004). Given this advice and the nature of this study, a non-experimental hypothesis testing design was adopted as most appropriate for this study. The study sought personal views, opinions, attitudes, and perceptions about causes of workers stress and their effect on the performance of the public universities which could be subjected to experimental design (Silverman, 2013).

The research design used for the study was a cross-sectional evaluation survey. This study collected information from workers in selected universities in Kenya thus making a survey effective in executing the research. An evaluation on the other hand involves the study of an organizational change, curriculum or innovation (Robert, 2002), which involved the evaluation of workers stress causative factors in public universities. However, the survey was cross-sectional survey since the data was collected at one particular time across the selected universities (Schurink, 2009). This research design was applied by the use of both suitable qualitative and quantitative research methods.

Quantitative research makes use of questionnaires, surveys and experiments to gather data that is revised and tabulated in numbers, which allows the data to be characterized by the use of statistical analysis (Denzin and Lincoln, 2005). Quantitative researchers measure variables on a sample of subjects and express the relationship between variables using effect statistics such as correlations, relative frequencies, or differences between means; their focus is to a large extent on the testing of theory. The study intended to establish the causes of workers stress and coping strategies which was collected using questionnaires. The factors were tabulated in the questionnaires and expressed using relative frequencies.

On the other hand, Creswell (2014) points out that there are several common characteristics of qualitative research, which includes: the data is collected in the field at the natural setting; researcher is a key instrument and they also use multiple forms of data collection such as interviews, observations, and documents rather rely on a single data source. This study employed qualitative research while generating data from specific participants on causes and effects of stress on performance and their coping strategies using interviews.

The target population refers to the subjects who possess attributes which the researcher wishes to study and a universe of units from which the sample is to be drawn Devos (2000). Bless and Higson-Smith (1995), define a target population as a set of elements on which the researcher focuses and from which the results obtained by testing the sample can be generalized.

The target population for this study was the staff of three selected public universities in Kenya. This included Jomo Kenyatta University of Agriculture and Technology, University of Nairobi, and Kenyatta University. This refers to the individual

workers; in all levels of employment, at the selected higher institutions as well as representatives from the staff welfare department and the institutions' administration in charge of human resources. Various departmental heads are also targeted as their responsibilities from time to time involve human

resources management. This gave a total target population of 12,805 workers from the three selected public universities as shown on table 3.1 below.

Table 3.1: Population of Workers in the Selected Public Universities

Selected public universities	University workers population
Jomo Kenyatta University of Agriculture and Technology	2,131
University of Nairobi	4,874
Kenyatta University	5,800
TOTAL	12,805

Source :(KUSU, 2014)

Cluster sampling technique was employed for the survey. The cluster sampling design involves the dividing of the population into mutually exclusive groups and then drawing random samples from each group to interview (Kumar R, 2005). This was necessary so as to ensure that the samples selected from each group are represented in the entire sample, which was selected for the study, in proportion to their numbers in the entire targeted population.

The Fishers formula was used to determine the appropriate sample size of this study. This was because the target population consists of a large number of units (public university workers) (Yates, 2004). The researcher assumed 95% desired level of confidence, which is equivalent to standardized normal deviate value of 1.96, and an acceptable margin of error of 5% (standard value of 0.05).

$$n = Z^2pq/d^2$$

Where:

n = the desired sample size (if target population is large)

z = the standard normal deviate at the required confidence level.

P = the proportion in the target population estimated to have characteristic being measured.

q = 1-p

d = the level of statistical significance set.

Assuming 50% of the population have the characteristics being measured, q=1-0.3

Assuming we desire accuracy at 0.05 level. The Z-statistic is 1.96 at this level

$$\text{Therefore } n = (1.96)^2(.5)(.5)/(0.05)^2 = 384$$

The targeted respondents from the selected public universities were categorized into three groups. These groups will include: The academic staff; the administrative staff; and the operative staff.

The cluster samples from the three selected universities were composed of respondent workers as shown on table 3.2.

Table 3.2: Composition of the Cluster Samples

Selected Universities	Public Academic staff		Administrative staff		Operative staff		Total Respondents	
	Actual	Cluster	Actual	Cluster	Actual	Cluster	Actual	Cluster
JKUAT	702	21	923	28	506	15	2,131	64
University of Nairobi	1,411	42	1,647	49	1,816	55	4,874	146
Kenyatta University	900	27	1,700	51	3,200	96	5,800	174
GRAND TOTAL	3,013	90	4270	128	5,522	166	12,805	384

The data collection tools used for the study were a questionnaire and interview schedules to obtain data from primary sources and a document review and analysis for secondary sources. These tools were selected after carefully considering the nature of the data to be collected, the target population, the time frame and the objectives/ research questions of the study.

a) Interviews

Interviews were important in situations where we cannot observe behaviour or when we do not know how participants experience their world (Cohen et al., 2007). Face-to-face interviews allowed the researcher an opportunity to explore the meaning participants attach to their experiences (Richards, 2003) in causes of their stress and how they are coping with such stress

situations. Face-to-face interview as well allowed the researcher to observe non-verbal cues and appropriately react or modify his inquiry in response to non-verbal cues (Yin, 2003) of participants particularly when they elicit confusion, uncertainty, or waning motivation.

The interviews were based on a prepared set of questions but these were only used as a guide. The research took the same position as Silverman (2013), that in qualitative study, questions are only used as a guide and departures from the guidelines are not seen as a problem but are often encouraged. The interview schedules involved the interviews of some key informants from the selected institutions of higher learning who are in one way or another involved in the welfare of the workers.

b) Questionnaires

Questionnaire has the advantage of being taken to a wider audience compared to interviews, but has a disadvantage of not being possible to customize it to individuals as it is possible with other methods of data collection. The questionnaire was the main data collection tool and it contained both open ended and closed ended questions. This study used two questionnaires that included: Self-evaluation of the determinants of workers' stress (Appendix 1) which was taken by participants in the pilot as well as the actual study to investigate the causes and effects of occupational stress among university workers; this questionnaire also attempted to determine their attitude towards such factors; and Self-evaluation of the effects of the stress factors on their performance and coping strategies employed by the workers in dealing with their stress and stressful situation, was taken by the participants during the actual study.

Primary data was gathered using interview guides and questionnaires which were self-administered. Cooper & Schindler (2004) state that self-administered interviews help to reach a large number of potential respondents in different locations. The questionnaires also helped to collect data from a large population of respondents at a short period of time.

The questionnaire and interview schedule were used to obtain both qualitative and quantitative data from the targeted respondents. Primary data collection was conducted by research assistants and me because of the different locations of institutions of higher learning. The data was collected over a period of one month to be able to meet the requirements of a cross-sectional survey. Secondary data was obtained from literature review and documents about workers stress in institutions of higher learning. The questionnaires with open ended questions on workers stress in public universities in Kenya were administered to selected workers representatives within the selected public universities in Kenya. This informed the second phase of data generation.

The second phase involved: a) administering questionnaires to the respondents who included university workers in the selected public universities; and b) conducting interviews with some key informants from the selected institutions of higher learning who are in one way or another involved in the welfare of the workers by use of interview guides. The questionnaires and the interview guides contained questions on the major issues raised in first phase.

Kombo and Tromp (2006) posit that after constructing a research instrument or questionnaire the researcher should try it out on a small sample of the population. This way of pre-testing or piloting of the instrument enables the researcher to ensure that the questions measure what they are supposed to; that the wording is very clear and unambiguous; that the questions provoke the intended responses and the researcher was able to analyze and know whether the questions posed are skewed towards certain issues more than others.

The questionnaire was pretested before its administration to ensure validity and reliability of the data to be collected. Validity was determined by the use of face validity and content validity. Face validity tests if the questions appear to be measuring the intended sections. On the other hand, content validity tests whether all the important aspects of the sections are measured. This was done by first testing the instruments on 10% of the target population and reviewing the findings. Reliability of the

responses was tested using the Cronbach alpha. Normally, α should be between 0.7 – 0.9 (Santos, 1999).

Data processing operations carried out included data editing/ cleaning and classification. Data editing/ cleaning is the examination of the collected data so as to detect omissions and errors and to correct them whenever possible. Data classification is the arranging of the collected data in classes or groups with common characteristics. The similar data was then tabulated before further analysis is conducted.

The tabulated data was then analyzed using both qualitative and quantitative techniques. Descriptive statistics was used for the analysis of the collected data, and this included parameters such as measures of central tendencies and the measure of dispersion. Inferential data analysis techniques such as regression and correlation analysis were also used to analyze the collected data. These parameters were used to determine and evaluate the relationships of the variables being measured. Data analysis and presentation of findings was carried out using statistical software which includes SPSS version 24 and Microsoft Excel. These software aided in the generation of suitable graphs, charts and tables which were used in drawing conclusions as well as presenting the research findings.

Regression is an important approach to modelling the relationship between the dependent variable (y) and one or more independent variable (x). A regression equation describes how the mean value of a response variable relates to specific values of the predictor variables (Bhattacharyya, 2011). The study used logistic regression analysis to test the statistical significance of the independent variables on the dependent variables.

Logistic regression is used to refer specifically to the problem in which the dependent variable is [binary](#), that is, the number of available categories is two (Hosmer and Stanley, 2000). The probabilities describing the possible outcomes of a single trial were modelled, as a function of the explanatory variables, using a [logistic function](#) (Hosmer and Stanley, 2000). Logistic regression was therefore used to measure the relationship between the categorical dependent variable and the independent variables by using probability scores as the predicted values of the dependent variable (Agestri, 2002).

The study used Binomial logistic regression. Binomial logistic regression refers to the instance in which the observed outcome can have only two possible types (Greene, 2003). The outcomes were coded as "0" and "1", as this lead to the most straightforward interpretation. The target group, the workers whose performance is affected (referred to as a "case") were coded as "1" and the reference group, workers whose performance is not affected (referred to as a "non-case") was coded as "0".

Logistic regression was used for predicting binary outcomes rather than continuous outcomes. It takes natural logarithm off the odds (logit or log-odds) to create a continuous criterion. The logit of success was then fitted to the predictors using regression analysis (Howell, 2010). The results of the logit were converted back to the odds via the inverse of the natural logarithm. Although the observed variables in logistic regression are categorical, the predicted scores were modelled as a continuous variable (the logit). The logit is referred to as the *link function* in logistic regression – although the output in logistic regression is binomial and displayed in contingency table, the

logit is an underlying continuous criterion upon which linear regression was conducted (Howell, 2010).

Faraway (2002), states that regression analysis is a statistical tool for the investigation of relationships between variables. Regression methods have become an integral component of any data analysis concerned with describing the relationship between a response variable and explanatory variables (Hosmer and Stanley, 2000).

The logistic regression equations for performance of workers being affected was expressed as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + e \quad (3.1)$$

Where; Y = Performance of workers being affected.

β_0 = Is the constant or coefficient of intercept.

X_1 = Working facilities stress.

X_2 = Workplace relationships stress.

X_3 = Management stress.

X_4 = Movement stress.

X_5 = Motivation stress.

$\beta_1 \dots \beta_4$ = The corresponding coefficients for the respective independent variables.

β_5 = Corresponding coefficients for the moderating variable.

Regression analysis was used by Gathungu and Wachira (2013) who studied the job satisfaction factors that influence the performance of secondary school principals in their administrative functions in Mombasa district, and Obwogi (2011) who studied the factors that affect quality of teaching staff in universities in Kenya.

Working facilities stress was measured by evaluating respondent's opinions on the contribution of the physical facilities available on their environment and the working conditions on their workplace stress. The dependent variable for the study was the performance of the selected public university workers. The workers performance was measured by assessing the physiological and psychological responses that are attributed to exposure to a stress factor.

IV. RESEARCH FINDINGS AND DISCUSSION

Workplace facilities were evaluated using six survey items on a five point likert scale. Most of the respondents (76%) agreed with the statements that they have all the facilities they require to do their work at place of work or office. Majority of the respondents (88%) supported the statement that "Every worker in my organization is accorded office space where and when needed". More than two thirds of the respondents (69%) agreed that offices at their place of work/section are enough and comfortable. On the other hand 60% of the respondent supported the assertion that the current facilities available to work with are adequate and enough for our needs. Almost all of the respondents agreed with the statements that "The location of my place of work and offices are well planned in line with our requirements and therefore appropriate-91%" and "The physical working conditions e.g., ventilation, space, cleanliness, are very good-86%".

Table 4.1: Workplace Facilities

Variable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I have all the facilities I require to do my work at my place of work or office	1%	3%	20%	15%	61%
Every worker in my organization is accorded office space where and when needed	6%	3%	3%	1%	87%
Offices at my place of work or section are enough and comfortable	6%	2%	22%	12%	57%
The current facilities available for us to work with are adequate and enough for our needs	14%	14%	6%	27%	38%
The location of my place of work and offices are well planned in line with our requirements and therefore appropriate	4%	2%	2%	41%	50%
The physical working conditions e.g., ventilation, space, cleanliness, are very good	2%	8%	4%	43%	43%

To provide a comparative description for the responses across the three universities, the average for each statement were

obtained as shown below. Great discrepancies among the respondents from the three universities were not observed.

Table 4.2: Workplace Facilities across Universities

Variable	University			
	Total	JKUAT	UoN	KU
d1 I have all the facilities I require to do my work at my place of work or office	4.3	4.4	4.2	4.4
d2 Every worker in my organization is accorded office space where and when needed	4.6	4.4	4.6	4.7
d3 Offices at my place of work or section are enough and comfortable	4.1	4.2	4.1	4.2

d4 The current facilities available for us to work with are adequate and enough for our needs	3.6	3.6	3.6	3.6
d5 The location of my place of work and offices are well planned in line with our requirements and therefore appropriate	4.3	4.3	4.3	4.3
d6 The physical working conditions e.g. ventilation, space, cleanliness, are very good	4.2	4.2	4.2	4.2
Average	4.1	4.1	4.0	4.2

Factor analysis Workplace Facilities

Workplace facilities in this study were evaluated using 6 items. The five point likert scale of (6) data items, was used to measure and determine the extent to which Workplace Facilities comprised of the desired outcomes. A correlation was first done on all the data items under Workplace Facilities and only those

that significantly correlated to each other were further reduced into few principal components. Results from correlations showed that “The physical working conditions e.g., ventilation, space, cleanliness, are very good –d6” did not correlate with most of other items and was therefore eliminated before running factor analysis.

Table 4.3: Correlations

	Statistic	d1	d2	d3	d4	d5	d6
d1	Pearson Correlation	1	.299*	.637**	.571**	.619**	.594**
	Sig. (2-tailed)		.033	.000	.000	.000	.000
	N	342	344	343	344	332	344
d2	Pearson Correlation	.299*	1	.637**	.619**	.594**	.299*
	Sig. (2-tailed)	.033		.000	.000	.000	.033
	N	51	50	50	51	50	51
d3	Pearson Correlation	.637**	.637**	1	.612**	.536**	.525**
	Sig. (2-tailed)	.000	.000		.000	.000	.000
	N	341	332	341	342	342	342
d4	Pearson Correlation	.571**	.619**	.612**	1	.607**	.176
	Sig. (2-tailed)	.000	.000	.000		.000	.217
	N	51	51	50	51	51	51
d5	Pearson Correlation	.619**	.594**	.536**	.607**	1	.101
	Sig. (2-tailed)	.000	.000	.000	.000		.332
	N	352	344	353	354	342	342
d6	Pearson Correlation	.594**	.299*	.525**	.176	.101	1
	Sig. (2-tailed)	.000	.033	.000	.217	.332	
	N	341	332	341	342	342	342

** . Correlation is significant at the 0.01 level (2-tailed).

The next table is used as to test assumptions; essentially, the Kaiser-Meyer-Olkin (KMO) statistic should be greater than 0.500 and the Bartlett's test should be significant (e.g. p < .05). The Kaiser-Meyer-Olkin of sampling adequacy was above the threshold of 0.5 (KMO=0.483) indicating that the sample size was adequate for the variables entered into analysis. The

Bartlett's Test of Sphericity was significant ($\chi^2=35.219$, $df=6$, $P=0.002$) showing that factor analysis using principal component was relevant for the data set and there were some relationships between the variables.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling		.483
Bartlett's Test of Sphericity	Approx. Chi-Square	35.219
	Df	15
	Sig.	.002

The table below shows the eigenvalues (variances of the principal components) associated with each linear component (factor) before extraction, and after extraction. The extraction converged in one iteration with one significant component with Eigenvalues accounting for 57.480% of the variance explained.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.024	57.480	57.480	4.024	57.480	57.480
2	.997	14.238	71.718			
3	.625	8.928	80.646			
4	.411	5.871	93.138			
5	.219	3.131	100.000			

Being above the threshold of 50% it indicated that the one-component factor model derived fitted the data appropriately. Items loading greater than 0.6 for the component combined to form the one principal component and the variables that clustered into it are shown in table below.

Table 4.4: Component Matrix

Variable	Component 1
d1 I have all the facilities I require to do my work at my place of work or office	.803
d2 Every worker in my organization is accorded office space where and when needed	.768
d3 Offices at my place of work or section are enough and comfortable	-.765
d4 The current facilities available for us to work with are adequate and enough for our needs	.607
d5 The location of my place of work and offices are well planned in line with our requirements and therefore appropriate	.602

Extraction Method: Principal Component Analysis.
 a. 1 components extracted.

The effect of performance and workplace facilities was examined by calculating the correlations.

Table 4.5: Correlation between Workplace Facilities and performance

	Not depressed	Don't feel bored	Does the best possible job	Enjoy work	Job Commitment	Responsible for actions at work	Motivated and productive creative	Stress produces poor work	Stress reduces productivity	Employee morale	Serves customer efficiently	Productive work	Efficient service delivery
d1	.011	.060	.077	-.099	.071	.225**	-.086	-.219**	-.278**	-.086	-.295**	-.172**	-.226**
d2	.065	.049	-.048	.060	-.150**	.095	.040	.061	.063	.003	-.154**	-.189**	-.059
d3	.083	.082	.003	.269*	.037	.155**	-.039	-.103	.353**	-.028	-.277**	-.023	-.213**
d4	.069	-.027	.097	-.019	.086	.086	-.005	.000	-.066	-.033	-.012	-.061	-.062
d5	.301**	.044	.094	-.024	.017	.072	-.011	.001	-.007	.002	-.019	-.057	-.089
d6	.128*	.052	-.090	-.101	.053	.090	-.054	-.028	.013	-.112*	-.055	-.039	-.018

	Not depressed	Don't feel bored	Does the best possible job	Enjoy work	Job Commitment	Responsible for actions at work	Motivated and productive creative	Stress produces poor productivity	Stress reduces productivity	Employee morale	Serves the customer efficiently	Productive work	Efficient service delivery
d1	.011	.060	.077	-.099	.071	.225**	-.086	-.219**	-.278**	-.086	-.295**	-.172**	-.226**
d2	.065	.049	-.048	.060	-.150**	.095	.040	.061	.063	.003	-.154**	-.189**	-.059
d3	.083	.082	.003	.269*	.037	.155**	-.039	-.103	.353**	-.028	-.277**	-.023	-.213**
d4	.069	-.027	.097	-.019	.086	.086	-.005	.000	-.066	-.033	-.012	-.061	-.062
d5	.301**	.044	.094	-.024	.017	.072	-.011	.001	-.007	.002	-.019	-.057	-.089
d6	.128*	.052	-.090	-.101	.053	.090	-.054	-.028	.013	-.112*	-.055	-.039	-.018

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Results showed that lack of depression and effective performance was positively significant at 0.01 level of significance on having all the facilities required to do work at place of work/ office (.301) and significant at 0.05 level of significance on location of place of work and offices well planned in line with our requirements (.128).

Enjoying work was positively and significantly correlated to offices at place of work or section being enough and comfortable (.269). Being committed to jobs was negatively and significantly correlated to every worker in the organization being accorded office space where and when needed (.150). Taking responsibility for actions within the job environment was positively and significantly correlated to having all the facilities required to do work at place of work or office (.255) and offices at place of work or section being enough and comfortable (.155).

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

The performance of the staff, both as teachers, researchers and managers, determines to a large extent, the quality of the student experience of higher education and has a significant effect on student learning and thereby on the contribution that such institutions can make to society. Responsibility for others is often associated with significant occupational stress. Each of the sources of stress that were assessed in this study was found to be significant and that each is a strong determinant of performance of the employees in the public universities and therefore should be given attention.

Working facilities refers to the resources that workers require to accomplish their tasks in the institution. The working facilities include both personal as well as job resources. These facilities buffer the negative effects of stress on the performance. The job facilities/resources mean those physical, psychological, social, or organizational facets of the job which are functional in achieving work related goals, which reduces job demands and the associated costs and which stimulate growth, learning, and development. On other side the personal resources refer to those resources, which are commonly associated with the people's self-

evaluation that enables them to control and influence their environment.

Although the respondents in this study indicate working facilities as the major source of stress that determines their performance in their workplaces, they are positive that the current work facilities in the universities do not expose them to stress. They indicated that they have all the facilities they require to do their work at place of work or office (76%); every worker in my organization is accorded office space where and when needed (78%); and that offices at their place of work/section are enough and comfortable (69%). Notably, almost all the respondents indicated that the location of their place of work and offices are well planned in line with their requirements and therefore appropriate (91%).

Management in this study refers to how the organization supervisors or leaders assign roles to their subordinates and how effectively those roles are assigned to enhance productivity. Working in a large, hierarchical, bureaucratic organization where employees have little control over their jobs can be very stressful. Additionally, when there is a high concentration of assignments at work: excessive work or work that is outside one's capability, employees gets stressed and perform poorly.

Since in management supervisors hold each employee accountable to their actions and duties, and for the quality of work they produce, role conflict that relates with mismatched role potentials, and role ambiguity which explains the uncertainty of what is expected, leads to stress and eventually interferes with the performance of the university workers.

Respondents were neutral on the statement of whether they were not depressed at work and therefore can perform their duties effectively. Respondents did not also know how to rate whether they felt always lazy, bored and headache lowering their output. Most of the respondents felt that they did not do the best possible job. However, most of the respondents enjoy their work and are committed to it.

Keeping in view the important role of university workers in ensuring that the institution achieves its objectives of sustaining economic and social development of the country, the concept of university workers performance has achieved a strategic significance. The performance of university workers is affected

by intra as well as extra organizational factors, which act as impediments to normal routine functioning of the workers. Once the routine functioning of the workers is disrupted, then the university workers develop feelings of exhaustion and frustration, and if the disrupted situation persists then negative dysfunctional feelings hit the workers which can be termed as stress, which is a reaction to the unwanted environmental stressors.

Workers under stress cannot perform well. Their job satisfaction and motivation levels are decreased and they show unwanted behaviours like absenteeism, mistakes during work, drugs use and abuse and violence at work. Furthermore they have more health related physical and psychological complaints. The university employees' satisfaction level is also decreased in such way that the university cannot offer quality education to the students. The resultant effect include complaints from parents and other stakeholders on the status of service delivery at the institutions, frequent strikes, dissatisfied employees and poor performance of the universities in general, and eventually overall image of the educational institution gets damaged.

The findings on the effects of working facilities stress factors on the performance of employees in public universities in Kenya confirm that there is a statistically significant influence of workplace facilities on employee performance. This implies that a positive increase in the conditions of workplace facilities leads to an increase in Employee performance. These results supports those of Botha & Pienaar (2006) who reported that income, heavy workload, lack of workspace, lack of resources (including equipment and material to do tasks), absence of proper company procedures, insufficient time to perform duties, meeting deadlines imposed by others, have been introduced as stressors related to work environment.

The management of public universities is responsible for ensuring that there are smooth operations within the institution. This calls for ensuring that employees are effectively and efficiently assigned roles that are in line with their abilities to perform. When employees are subjected to a high concentration of assignments at work: excessive work or work that is outside one's capability, employees get stressed and perform poorly. Additionally cases of role ambiguity and role conflict can minimise the ability of the employees to deliver of their roles effectively. As such their performance and productivity will be lowered. It hence follows that poor management exposes the employees to stress, reducing their performance. Conclusively the study confirms that there is a statistically significant influence of management on employee performance. This implies that a positive increase in management score leads to an increase in employee performance.

REFERENCES

- [1] Addae H.M., Parbooteah K.P. and Velinor N. (2008), Role stressors and organizational commitment: Public sector employment in St. Lucia, *International Journal of Manpower*, 26(6), 567-582
- [2] Addae H.M., Parbooteah K.P. and Velinor N. (2008), Role stressors and organizational commitment: Public sector employment in St. Lucia, *International Journal of Manpower*, 26(6), 567-582
- [3] Akbar, A. (2011). Faculty Stress at Higher Education: A Study on the Business Schools of Pakistan: *World Academy of Science, Engineering and Technology*, 1082.
- [4] Al-Aameri S. (2003). "Source of job stress for nurses in public hospitals": *Saudi Medical Journal*, 4(11), pp.1183- 1187.
- [5] Alexandros-Stamatios G. A.et al, (2003), "Occupational Stress, Job satisfaction, and health state in male and female junior hospital doctors in Greece", *Journal of Managerial Psychology*, 18(6), pp. 592-621
- [6] Allen et al (2000), "Consequences Associated with Work Family conflict: a review and Agenda for future Research"; *Journal of occupational Health Psychology* vol. 5 Pg. 278-308.
- [7] Arnold B.et al (2007), Job resources boost work engagement, particularly when job demands are high, *Journal of Educational Psychology*, 99(2), 274-284.
- [8] Aryee, S. et al (1998), "Family Response variables and Retention Relevant outcomes among Employed Parents." *Human Relations* vol. 51 Pg. 73-87.
- [9] Bachkirova, T., (2005), Teacher stress and personal values: An exploratory study. *School Psychology International*, 26(3), 340-352.
- [10] Balt, R. & Valcour, M., (2003), "Human Resource Practices as predictors of work family outcomes and Employee Turnover" *Industrial Relations*. Vol. 42 Pg. 189-220.
- [11] Barling, et al (2004), *Handbook of work stress: New York, USA*.
- [12] Barnett, R.C., (2004) "Work hours as a predictor of stress outcomes" paper presented at a conference towards a National Research agenda: University of Maryland.
- [13] Barsky, A., et al (2004), "Modelling Negative Affectivity and job stress: A contingency Approach." *Journal of Organizational Behaviour*, vol. 36, pp. 915-936.
- [14] Bashir, U. (2010), Impact of Stress on Employees Job Performance: A Study on banking Sector of Pakistan; *International Journal of marketing Studies*, Vol. 2, 122.
- [15] Beehr, T. A. (2005), *Psychological Stress in the Workplace*, London and New York.
- [16] Betoret T., (2006) Stressors, self-efficacy, coping resources and burnout among secondary school teachers in Spain, *Educational Psychology*, 26(4), 519-539.
- [17] Blomme, R.J., et al (2010), Work-family conflict as a cause for turnover intentions in the hospitality industry: *Tourism and Hospitality Research*, 10(4), 269-285.
- [18] Bloona, R., (2007), *Coping with stress in a changing world: New York McGraw – Hill*.
- [19] Botha C & Pienaar J., (2006), South African correctional official occupational stress: the role of psychological strengths: *Journal of Criminal Justice*. 34(1): 73-84.
- [20] Bradley j. (2007) Job tenure as a moderator of stressor–strain relations: A comparison of experienced and new-start teachers, *Work and Stress*, 21(1), 48-64.
- [21] Brown, Z. A., & Uehara, D. L. (2008).Coping with teacher stress: A research synthesis for Pacific education. www.prel.org: Accessed on 5th December 2013.
- [22] Brown, Z. A., & Uehara, D. L. (2008).Coping with teacher stress: A research synthesis for Pacific education. <http://www.prel.org>
- [23] Cannon, and Walter, B., (1929) *War conflict: Double Rainbow*. Inc Data Render time: 623.
- [24] Caulfield, N., et al (2004) A reviews of occupational stress interventions in Australia: *International Journal of stress management* vol. 11 pg. 149-166.
- [25] Certo S.C. (2003), *Supervision: Concepts and skill building*, New York, NY: McGraw Hill
- [26] Chan H (2003), Hardiness and its role in the stress-burnout relationship among prospective Chinese teachers in Hong Kong, *Teaching and Teacher Education*, 19(4) , 381-395.
- [27] Chang, K., & Lu, L., (2007), Characteristics of organizational culture, stressors and wellbeing: The case of Taiwanese organizations: *Journal of Managerial Psychology*, 22, 549-568.
- [28] Chang, K., & Lu, L., (2007), Characteristics of organizational culture, stressors and wellbeing: The case of Taiwanese organizations: *Journal of Managerial Psychology*, 22, 549-568.
- [29] Chaudhry, A. Q. (2012). An Analysis of Relationship between Occupational Stress and performance .*Bulletin of Education and Research*, 13.

- [30] Cherry, N. M., et al. (2006), "Reported incidence and precipitating factors of work-related stress and mental ill-health in the United Kingdom (1996-2001)": *Occup Med (Lond)* 56(6): 414-421.
- [31] Cohen, S. and Williamson, G.M., (1991), Stress and infectious diseases in humans: *Psychology Bull* vol. 109 p 5-24.
- [32] Coleman, V., (1998) *Stress management Techniques managing for Healthy profits*. London: Cox T. 1980 stress, Maryland University park press.
- [33] Cox, T., Griffiths, A. & Rial-Gonzalez, E. (2000), *Research on Work-Related Stress*, Office for Official Publications of the European Communities: Luxembourg.
- [34] Dar L., Akmal A., Naseem A.M. and Khan K.U. (2011), Impact of stress on employee job performance in business sector of Pakistan, *Global Journal of Management and Business Research*, 11(6), 1-4
- [35] Deaconu, G., (2011), "Stress management strategies for organizations." *Psychology Review*, July.
- [36] Dua, J., (1994), "Job stress and their effects on physical Health, Emotional Health and Job Satisfaction": *Journal of Education and Administration*. Vol. 32, pg. 59-78.
- [37] Falkum, E. et al (1997), Revisiting the factor structure of the ways of coping checklist: a three-dimensional view of the problem-focused coping scale: A study among Norwegian physicians; *Personality and Individual Differences*, 22, 257-267.
- [38] Folkman, S. et al (1986), Appraisal, Coping, Health Status, & Psychological Symptoms, *Journal of Personality and Social Psychology*, 50, 571-579.
- [39] Friedman, M., and Roseman, R., (1974), "Type A Behaviour and Your Heart." Greenwich: Fawcett publications.
- [40] Giga, S., (2011), *The Implied Employment Relationship: Investigating the effects of psychological contract violations on Employee Wellbeing*: Doctoral Thesis University of Manchester Institute of science and Technology, Manchester.
- [41] Glenn, D. I., (2012), "Determining Sample Size, PEO6." University of Florida; IFAS Extension: Obtained from <http://edis.ifas.ufl.edu>.
- [42] Greenberg, J., and Baron, R., (2007) "Behaviour in organizations." New York: Prentice Hall.
- [43] Guglielmi, R., & Tatrow, K. (1998), Occupational stress, burnout, and health in teachers: A methodological and theoretical analysis. *Review of Educational Research*, 68(1), 61-99.
- [44] Hackman, J. R., & Oldham, G. R. (1980). *Work Redesign*, Reading, MA: Addison-Wesley.
- [45] HavLovic, J. & Keenan, P., (1991), "Coping with stress: The influence of Individual Characteristics"; *Journal of Social Behaviour*. Vol. 6, pg. 25-51.
- [46] He, N. et al (2005), Do race and gender matter in police stress: A preliminary assessment of the interactive effects: *Journal of Criminal Justice*. 33(6): 533-47.
- [47] IvaneRich, J. et al (2006), "Organization Behaviour and Management": New York; Mc. Graw Hill.
- [48] Jayashree, N., (2008), "Factors influencing stress and coping strategies among the Degree College Teachers of Dharwad City, Karnataka": Unpublished Msc thesis, University of Agricultural Sciences, Dharwad.
- [49] John, J., (2009), Hedrich Centre for workforce Development, "Work and Family Pressures Undercutting": *Journal of Technology and Education in Nigeria*. Vol. 12(2) pg. 9-18.
- [50] Judge Sharon, (2003), "Determinants of parental stress in Families Adopting Children from Eastern Europe": National council on Family Relations. Vol. 52 (3) pg. 241-248.
- [51] Kaplan, H.G., et al (2004), "Efficacy and Safety of different doses": *Journal of Cannabis Therapeutics* (2001-2004).
- [52] Karasek, R., et al., (1981), "Job decision latitude, job demands and cardiovascular disease: a prospective study of Swedish men": *American journal of public health*, (71) pg. 694-705.
- [53] Karatepe, O.M. et al (2012), Affectivity and organizational politics as antecedents of burnout among frontline hotel employees: *International Journal of Hospitality Management*, 31(1), 66-75.
- [54] Khanka, S.S., (2007) "Corporate Behaviour." New Delhi, Chand and company Limited.
- [55] Kolt G. (2003), Eustress, distress, and interpretation in occupational stress, *Journal of Managerial Psychology*, 18(7), 726-744
- [56] Kompier, M., (2003), Job Design and Well-being: In M. Schabracq, J. Winnubst & C.L. Cooper, (Eds.), *Handbook of Work and Health Psychology*, 429-454.
- [57] Konirigield, et al (2004), "Work Related Stress": European Foundation for Improvement. www.eurofound.europa.eu/...rts/TN0502TRO1/TNO502TR.
- [58] Kreitner, R., Kinicki, A., (2007), "Organizational Behaviour:" Mc. Graw Hill.
- [59] Kumar, I. A. (2013), Occupational Stress among Male and Female Elementary School Teachers of District Pulwama: *International Journal of Scientific & Engineering Research*, 940.
- [60] Kumar, R., (2005) *Research Methodology-A Step-by-Step Guide for Beginners*, Pearson Education. 2nd ed, Singapore.
- [61] Landa, J. M.A. et al (2008), The relationship between emotional intelligence, occupational stress and health nurses: a questionnaire survey; *International Journal of Nursing Studies*. 45(6): 888-901.
- [62] Larson, L. L. (2004). Internal auditors and job stress. *Managerial Auditing Journal*, 19, 1119-1130.
- [63] Larson, L. L. (2004). Internal auditors and job stress. *Managerial Auditing Journal*, 19, 1119-1130.
- [64] Larson, L. L. (2004). Internal auditors and job stress. *Managerial Auditing Journal*, 19, 1119-1130.
- [65] Le Fevre M., Matheny J. and Kolt G. (2003), Eustress, distress, and interpretation in occupational stress, *Journal of Managerial Psychology*, 18(7), 726-744
- [66] Le Fevre M., Matheny J. and Kolt G. (2003), Eustress, distress, and interpretation in occupational stress, *Journal of Managerial Psychology*, 18(7), 726-744
- [67] Lee, David, (2009) *Managing Employee Stress and Safety*, Brochure: Author Memic.
- [68] Lind, S.L., and Otte, F.L., (1994) Management styles mediating variables and stress among HRD professionals, *Human Resource Development*. Winter: pg. 301.
- [69] Lu CQ, et al (2005), Managers' occupational stress in China: the role of self-efficacy: *Personality and Individual Differences*. 38(3):569-78.
- [70] Luthan, F., (2008), *Organizational Behaviour*: New York: Mc. Graw Hill.
- [71] Mairura, L., (2009), "counselling for Teenagers with chronic stress: A case of students in Nairobi Day Schools." Nairobi, Kenya
- [72] Margets, E.L., (1975), "Stress, Homeostasis and the Human Ecological continuum": *Journal of Society, Stress and Distress*. vol. 2. Pg. 22-36.
- [73] Mark, G.M. & Smith, A. P. (2008), The relationship between workplace stress and job characteristics, individual differences, and mental health.
- [74] Mc. Gart, J., (1976), *Social and Psychological Factors in Stress*. New York: Holt and Rinchart.
- [75] Mc. Hugh, M., (1997) "The stress factor: another Item for change management Agenda." *Journal of Organizational change* vol. 10 pg. 345-362.
- [76] Mc. Shane, S., Von. Glinow, and Sharma, R., (2008) *Organizational behaviour*. New Delhi: Mc. Graw.
- [77] Miller, L., (2009) *Stress Causes Rigidity (PhD)*. The Business case for stress management – 4 imprint .Info.4imprint.com/...t/uploads/M0709-02 blue-papers.
- [78] Mohammadi Z. et al. (2013), Evaluation of relationship occupational stress with shift work in the agency drivers in Yazd: *Occupational Medicine*, Vol. 6, No. 3
- [79] Mohanraj, P. & Manivannan, L., (2013), Occupational stress among migrated workers in unorganised sectors : IRACST- *International Journal of Research in Management & Technology (IJRMT)*. Vol. 3, No.1.
- [80] Mojoyinola, J. K. (2008), Effects of Job Stress on Health, Personal and Work Behaviour of Nurses in Public Hospitals in Ibadan Metropolis, Nigeria: *Journal of Social Work* , 143-148.
- [81] Munalu, J., (2005), "Stress and Individual Performance of workers in Hotels at the Kenyan coast": Unpublished M.A. thesis, Cornell University USA.
- [82] Musyoka, M. et al (2012), Employee stress and performance of companies listed in the Nairobi securities exchange: *DBA Africa Management Review* 2012, vol.3. No. 1 pp 115-129.
- [83] Naituli, B.K., (2008), "Leadership practices and the influence of stress: A study of Kenyan managers": Unpublished thesis, Egerton University.

- [84] Nakata, A., M. Takahashi, et al. (2008). "Perceived psychosocial job stress and sleep bruxism among male and female workers." *Community Dent Oral Epidemiol* 36(3): 201-209
- [85] National Occupational Health and Safety Commission (2003), 'Compendium of workers' compensation statistics, Australia, 2000-2001: Canberra, Australia. NEL MH, (2004)
- [86] New Stroom, J., (2007) organization behaviour: human behaviour at work. New Delhi: Mc. Graw Hill.
- [87] Ng'ethe, J.M. (2012), Determinants of Academic Staff Retention in Public Universities in Kenya: Empirical Review. *International Journal of Humanities and Social Science* Vol. 2 No. 13
- [88] Ngeno, G., (2007) "Causes of Burnout among primary school Teachers within Kericho municipality, Kenya."
- [89] Ngome, C.K. (2010) Massive Growth of University Education in East Africa and the Challenges facing the Sector from 2000 to 2011: The case of Kenya, IUCEA conference, 19th-21st October, 2010, Kampala, Uganda.
- [90] Nilufar, et al (2009) International conference on Business and Economic Research, Academic report has been reported all over the world.
- [91] NIMH (2013), Stress for Adults: How it affects your health and what you can do about it. Available at: http://www.nimh.nih.gov/health/publications/stress/Stress_Factsheet_LN_142898.pdf
- [92] Noblet, A., (2003) "Building Health promoting work settings: Identifying the relationship between work characteristics and occupational stress in Australia" *Health Promotion International*. Vol.18 (4) pg.351-359.
- [93] Obwogi, J. (2011), Factors that affect Quality of Teaching Staff in Universities in Kenya. PhD Thesis, Jomo Kenyatta University of Agriculture and Technology
- [94] Olali, B., (2005), "Stress and Individual Performance: A case of Kaimosi Teachers College" Unpublished M.A.; Thesis Moi University, Kenya.
- [95] Owino, G. et al (2011), Role of institutional managers in quality assurance: reflections on Kenya's University education: *Australian Journal of Business and Management Research*. Vol.1 No.2
- [96] Pabla, D. M. (2012), Occupational Stress Amongst Teachers of Professional Colleges in Punjab: *Indian Journal of Research*, 112.
- [97] Park, C.L. & Folkman, S. (1997), Meaning in the context of stress and coping, *Review of General Psychology*, 2, 115-144.
- [98] Park, C.L. & Folkman, S. (1997), Meaning in the context of stress and coping, *Review of General Psychology*, 2, 115-144.
- [99] Perrewe, P.L., & Zellars, K.L. (1999), An examination of attributions and emotions in the transactional approach to the organizational stress process: *Journal of Organizational Behaviour*, 20, 739-752.
- [100] Pestonjee, D.M., (1992), *Stress and Coping*. Sage publications New Delhi.
- [101] Pierce J., & Delahaye, B., (1996), Human Resource management implications of dual-career couples. *International Journal of Human Resource management* (v7) pg. 905-923.
- [102] Porter, and Steers, (1987), Effects on role loss on work-related attitudes. *Journal of Applied Psychology* vol. 72(2) pg. 287-293.
- [103] Ramzan, M., (2012), A Study on Understanding the Factors Contributing To Teachers' Professional Stress in the Private Schools of Gilgit-Baltistan. *Strength for Today and Bright Hope for Tomorrow*, 349
- [104] Repeth, R.L (1993), "The effect of workload and Sonal Environment on Healthin L. Goldberger and S. Breznitz (Ed). *Handbook of stress: Theoretical and Clinical Aspects*. pp 120-130
- [105] Robbins S. et al (2009), *Organization and stress management*: New Delhi, India; Dorling Kindersley
- [106] Robbins, and Judge, (2007), *Organizational behaviour*: New Jersey; Pearson Education.
- [107] Robbins, S., (2003), *Organizational behaviour*: New Jersey; Pearson Education. Rutgers University.
- [108] Robert, J. C., (2002) Types of Research Design: Analyzing, Interpreting & Using Educational Research. Resources for the Ed. D. unit, Research Methods, 2002 found at www.dur.ac.uk/r.j.coe/resmeths/types.doc.
- [109] Rosania, A. E., K. G. Low, et al. (2009). "Stress, depression, cortisol, and periodontal disease": *J Periodontol* 80(2): 260-266.
- [110] Santos, J. R. A., (1999) Cronbach Alpha: A Tool for Assessing the Reliability of Scales. Available at <http://www.joe.org/joe/1999april/tt3.html>.
- [111] Sayeed, O.M., (2001), *organizational commitment and conflict*. New Delhi: Sage publication.
- [112] Selye, H., (1956) *Stress of Life*. McGraw Hill: New York.
- [113] Spector, P.E., (2002), "Employee Control and Occupational Stress": Sage publications, vol.11 (4) pg. 133-136.
- [114] Sultana, B. (2012), The Nature and Impact of Teacher Stress in the Private Schools of Gilgit-Baltistan, Pakistan: *International Journal of Academic Research in Progressive Education and Development*, 82, 83.
- [115] Sveinsdottir, H., et al (2006). Occupational stress, job satisfaction, and working environment among Icelandic nurses: a cross-sectional questionnaire survey: *International Journal of Nursing Studies*. 43(7): 875-89.
- [116] Tetey, J.W. (2009), Deficits in Academic Staff Capacity in Africa and Challenges of Developing and retaining the next Generation Academics: Partnership for Higher Education in Africa.
- [117] Trice, H.M. & Sonnenstuhl, W.J., (2010), "The construction of drinking norms in work organizations": *Journal of studies on Alcohol* vol. 51, pg. 201-220.
- [118] Vakola, M., & Nikolaou, I. (2005), Attitudes towards organizational change: What is the role of employees' stress and commitment? *Employee Relations*, 27, 160-174.
- [119] Vitaliano, P.P. et al (1985), The Ways of Coping Checklist Psychometric Properties, *Multivariate Behavioural Research*, 20, 3-26.
- [120] Warr, P., (1990), The Measurement of Well-being and Other Aspects of Mental Health.: *Journal of occupational psychology*. (v.52) pg. 129-148.
- [121] Waswa F. & Swaleh S. (2012), Faculty opinions on emerging corporatization in public Universities in Kenya. *Education and General Studies* Vol. 1(1) pp. 009-015
- [122] Webster, T., & Bergman, B., (2009), Two international conferences on management 969 (21CM 2012): Occupational stress: counts and rates compensation and working conditions. Washington, USA.
- [123] Welford, A., (1973), "Stress and performance": *Ergonomics*, vol. 16 pg.567.
- [124] West, H., & Mackay, J., (1999), "Employment Roles and Counsellors in Employee Assistance Programmes": *Journal of counselling psychology*. Vol.7 pg. 355-389.
- [125] White E. (2006), Opportunity knocks and it pays a lot better, *The Wall Street Journal*, 13
- [126] Wilson, B., (2007) *Wilson Heart care, Heart Math and Cardiologist...publications in January 2007(PhD)*. www.wilsonheartcare.com/bio.2.html
- [127] Workplace Relations Ministers' Council (2003) Comparative performance monitoring, fifth report,' Australia and New Zealand Occupational Health and Safety and workers' compensation schemes,' Canberra.
- [128] Worrall, L., & Cooper, C., (1999), *Quality of working life survey*: Institute of Management, London.
- [129] Yagil, D., (1998). If anything can go wrong, it will: occupational stress among inexperienced teachers: *International journal of stress management*. (v5) pg. 179-188.
- [130] Yamane, Y., (1976) *Statistics: An introductory Analysis*, 2nd Ed. New York: Harper and Row.
- [131] Yambo, J.M.O. et al (2012), Investigating High Schools Principals Stress in Relation to their job experience in schools in Southern Nyanza Region of Kenya: *International Journal of Academic Research in Progressive Education and Development*, vol. 1, No. 4 ISSN 2226-6348.
- [132] Zhimin, L. & Ramani K., (2012), A study on the conflict resolution mechanisms in higher educational institutions: A case of Kenya's public universities. *Educational Research Journals* Vol. 2(6), pp. 208-216.

AUTHORS

First Author – John Ng'ang'a Karihe, Doctor of philosophy in Human Resources Management of Jomo Kenyatta University of Agriculture and Technology
Second Author – Professor G. S. Namusonge, Supervisor, Jomo Kenyatta University of Agriculture and Technology

Third Author – Dr. Mike Iravo, Supervisor, Jomo Kenyatta

University of Agriculture and Technology

APPENDIX 3: TABLES
Table 4.6: Correlations for Employee Performance

	Statistic	g1	g2	g3	g4	g5	g6	g7	g8	g9	g10	g11	g12	g13
g1	Pearson Correlation	1	.009	.012	-.080	.069	.033	-.067	-.019	-.011	-.060	-.037	-.033	-.098
	Sig. (2-tailed)		.871	.833	.153	.205	.544	.217	.726	.845	.273	.498	.541	.075
g2	Pearson Correlation	.009	1	-.025	-.070	.110	.176**	.286**	.141*	-.188**	.265**	-.147**	-.074	.139*
	Sig. (2-tailed)	.871		.658	.229	.053	.002	.000	.013	.001	.000	.009	.197	.016
g3	Pearson Correlation	.012	-.025	1	.104	-.037	-.025	.030	-.016	.028	-.008	-.075	-.059	-.006
	Sig. (2-tailed)	.833	.658		.064	.502	.645	.582	.776	.618	.881	.172	.284	.920
g4	Pearson Correlation	-.080	-.070	.104	1	.076	-.113*	.248**	.040	.261**	.309**	-.261**	-.121*	-.061
	Sig. (2-tailed)	.153	.229	.064		.169	.041	.000	.473	.000	.000	.000	.028	.278
g5	Pearson Correlation	.069	.110	-.037	.076	1	.022	-.121*	.015	-.157**	.136*	.151**	.277**	-.063
	Sig. (2-tailed)	.205	.053	.502	.169		.682	.025	.778	.004	.011	.005	.000	.249
g6	Pearson Correlation	.033	.176**	-.025	-.113*	.022	1	-.155**	.117*	.081	.068	-.273**	-.358**	-.209**
	Sig. (2-tailed)	.544	.002	.645	.041	.682		.004	.030	.134	.212	.000	.000	.000
g7	Pearson Correlation	-.067	.286**	.030	.248**	-.121*	-.155**	1	.162**	.211**	.462**	-.214**	-.140**	.228**
	Sig. (2-tailed)	.217	.000	.582	.000	.025	.004		.003	.000	.000	.000	.009	.000
g8	Pearson Correlation	-.019	.141*	-.016	.040	.015	.117*	.162**	1	.118*	.312**	.022	-.005	.237**
	Sig. (2-tailed)	.726	.013	.776	.473	.778	.030	.003		.028	.000	.688	.933	.000
g9	Pearson Correlation	-.011	-.188**	.028	.261**	-.157**	.081	.211**	.118*	1	.176**	-.070	-.026	-.048
	Sig. (2-tailed)	.845	.001	.618	.000	.004	.134	.000	.028		.001	.194	.637	.382
g10	Pearson Correlation	-.060	.265**	-.008	.309**	.136*	.068	.462**	.312**	.176**	1	.101	.107*	.345**
	Sig. (2-tailed)	.273	.000	.881	.000	.011	.212	.000	.000	.001		.061	.049	.000
g11	Pearson Correlation	-.037	-.147**	-.075	-.261**	.151**	-.273**	-.214**	.022	-.070	.101	1	.693**	.192**
	Sig. (2-tailed)	.498	.009	.172	.000	.005	.000	.000	.688	.194	.061		.000	.000
g12	Pearson Correlation	-.033	-.074	-.059	-.121*	.277**	-.358**	-.140**	-.005	-.026	.107*	.693**	1	.218**
	Sig. (2-tailed)	.541	.197	.284	.028	.000	.000	.009	.933	.637	.049	.000		.000
g13	Pearson Correlation	-.098	.139*	-.006	-.061	-.063	-.209**	.228**	.237**	-.048	.345**	.192**	.218**	1
	Sig. (2-tailed)													

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Role of Extended Producer Responsibility in context of electronic waste-Case of India

Anupam KHAJURIA*

*PhD. Dr. of Eng., *Researcher, Environmental Unit,
United Nations Centre for Regional Development, Nagoya, Japan

Abstract- Electronic waste is one of the fastest growing waste streams in the world. Due to the absence of effective and suitable treatment technology, this waste can pose a serious health and environmental hazards. Developing countries such as India is facing enormous challenges and problems related to the rapid generation and disposal of electronic waste. The present study attempted to identify the current challenges and constraints of electronic waste in India. This paper also identifies and analyze the significant role of Extended Producer Responsibility (EPR) policy in handling and effective management of electronic waste.

Index Terms- Electronic waste, Extended Product Responsibility, Recycle, Management, India

I. INTRODUCTION

As the Asian countries industrially and economically grow, the new emerging waste streams such as industrial waste, electronic waste, plastic waste in coastal and marine environment, construction and demolition waste, hazardous and chemical waste have become a matter of serious concern for sustainability. The electronic waste includes the discarded electronic and electrical equipment/appliances. The rapid economic growth, coupled with urbanization and industrialization results the increasing consumption and production of electronic waste and its rapidly growing increase in the near future. Robinson [1] stated that changes in technology will affect the global mass of electronic waste produced. This study also specifies that the electronic waste describes the waste electronic goods such as computers, televisions and cell phones, and also indices traditionally non-electronic goods such as refrigerators, ovens and washing machine. With the aiming to ensuring the proper and effective management of electronic waste, some framework and targets of reuse, recycle and recovery are acknowledged. Ongondo and Williams [2] provide a detailed analysis of electronic waste management practices in various countries and regions around the world, concluding that the rate of initiating legislation to deal with electronic waste is advancing very slowly around the world and is indeed inconsistent in some cases.

India is one of the rapidly growing economies of the developing countries. Since 1990, the first phase of economic liberalization, the problems associated with electronic waste in India have started manifesting [3]. The continuing growth, challenges and problems of electronic waste, causing a serious problem to the environment and human health. Electronic waste is new and emerged stream of waste as compared to municipal waste.

Conventional waste management technologies and policies are more suited to handle and treat the municipal waste as compared to electronic waste because of its different characteristics. Electronic waste contains toxic substances which pose a threat to the environment and human health, as well as the valuable raw material which can be recovered by using proper and effective treatment technologies. In India, electronic waste is one of the highest rank in the domestic generation and import include legal or illegal imports. Extended Producer Responsibility (EPR) is one of the best policy which is increasingly recognized worldwide as an effective and efficient electronic waste management policy with the applicability in the area of end-of-life management of the product.

In order to tackle the problem of e-waste management, it is necessary to first develop a better understanding and discuss the challenges and opportunities of electronic waste recovery, embarking on an Extended Producer Responsibility (EPR). In addition, we have also discussed in detail of EPR impact and efficiency, especially in case of India.

II. EXTENDED PRODUCER RESPONSIBILITY (EPR) AND ITS SIGNIFICANCE

Extended Producer Responsibility is defined as an environmental protection strategy that makes the manufacturer of the product responsibility for the entire life cycle of the product and especially for the take back, recycling and final disposal of the product [4]. EPR is an environment policy approach that attributes responsibility to manufactures in taking back products after use, and is based on polluter-pays principles. Thus, the producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle [5]. With the aim to reduce the environmental impact of the life-cycle of the product, EPR pays its attention to the pollution emerging from the last stage of product disposal and recycle. EPR is most commonly applied for home appliances under Home Appliances Recycling Law in Japan [6], for packaging waste under Packaging Ordinance in Germany [4] and for Automobile waste in under Sweden Law [7]. Matsuto [8] examined domestic efforts to recycle used home appliances in Japan, focusing on recent legislation (the Home appliances Recycling Law) that requires appliance producers to take responsibility for the collection and recycling of end-of-life products. It shows that the electronic waste is highly enforced with EPR policy and law. Recycling and transportation fees are paid by consumers and discarded appliances are sent to recycling facilities.

There are main two tasks of EPR- (a) to increase the collection and reuse and recycle the product; and (b) financial responsibility

throughout the life cycle of the product. EPR includes the four main approaches- Product take-back approach, market-based approach, quantity standard approach and economic approach. In the region of western Canada, the EPR is managed by companies which would pay for the environmental handling charge when import oil and also a rewarding fee to benefit the collector and processors recycling the oil [9]. The recycled oil further processed as lubricating oil or other petrochemical goods, and the revenue is used for environmental handling cost. In developing countries, government and municipalities play an important role in product take-back approach and providing recycling infrastructure [10]. For progressive EPR policy, the producers have full responsibility of the environmental impacts in the whole life-cycle of the product [11].

III. BENEFITS OF RECYCLING PROCESS

The continue development in recycling and recovery technology establish the investment in infrastructure of the country. A life cycle assessment approach of plastic waste would assist in identifying the environmental impacts associated with management and EPR policy. In other words, plastic reused products have been able to benefit society in terms of economic activity, jobs and quality of life. Recycling activities of plastic waste could help reduce energy consumption and greenhouse emissions and packaging applications. The recycling activities needs to be carried out in a sustainable manner, which provide a wide variety of recycled plastic applications and the market would grow rapidly. In addition, the recycling activities input the interest in terms of economic impact by raising the recycling sector and potential increase in economic growth and social impact is anticipated to be associated as a health and environmental risks.

IV. CHALLENGES AND CONSTRAINTS OF ELECTRONIC WASTE –CASE OF INDIA

Waste management is a very massive task in India, and becoming more complicated with invasion of electronic waste, which contains hazards and toxic substances. In addition, the electronic industry has emerged at a higher rank in terms of production, consumption, import and export. The main source of electronic waste are divided into main two sectors, formal sector includes manufacturer, producer, retailer, consumers, traders and informal sector includes smelters, dismantlers and recycling facilities [12]. The transboundary movement of hazards waste, particularly contentious when the waste exports from developed to developing countries. Dwivedy and Mittal [13] try to evaluate the future trends of computer waste generation in India by utilizing their first lifespan distribution and historical sales data. The results of his study indicate that in the year 2020, about 41 to 152 million units of computers will become obsolete. Of the electronic waste imported into India, it is estimated that approximately 80 percent is imported from the US, while the remaining 20 percent is predominately imported from the EU countries [14]. Nonetheless, as the import of electronic waste is illegal and it is often shipped via third countries, that is unrealistic to expect these statistics to be exact [15]. In India, the Central Pollution Control Board (CPCB) puts forward the Draft guidelines for environmentally sound management of electronic

waste in 2007 and E-waste (Management and Handling) Rules, 2011 for public consultation and suggest the EPR policy [16]. EPR policy and programs introduce the producer's liability, physical, financial and informative responsibility are extended to cover the end-of-life of the product.

According to a Delhi-based non-governmental organization (NGO) Toxic Links, India annually generate 1.5billion \$ worth of electronic waste domestically, with the blooming IP sector being the largest contributor, as 30 percent of its machines reach obsolescence annually [12]. 70 percent of electronic waste is collected from export or dump by developed countries, because it's financially profitable to send electronic waste for reuse and recycle in developing countries [17]. Because lack of awareness of treatment and disposal of domestic electronic waste, citizens usually discard the electronic waste with the municipal waste stream, which is highly insignificant for the environment.

In this way, the first priority should be to reduce its generation, however, the consumers in exporting countries are changing their lifestyles. The reuse and recycle of electronic waste, mainly focuses on the characteristics of the product- quality, stability of reuse product, environmental impact of reuse product, socioeconomic impact of reuse product. Recycling involves the disassembly and destruction of the electronic item to recover the raw material [18]. Reuse and recycle are very lucrative business in the second-hand market of re-useable product in India. However, the EPR policy and program is limited to reuse and recycle options. The reuse 'redesign' helps to solve the obstacles of interface with the economic market in second hand and recycled market. However, the management of electronic waste has severe environment and human health implications. Usually stakeholders play an important role in managing the electronic waste but have a negligible role in the generation of electronic waste, whatever electronic waste is produced during the redesign.

V. IMPLICATIONS OF ELECTRONIC WASTE ON ENVIRONMENT AND HUMAN HEALTH

Leung et al. [19] focused on the adverse effects of the hazards substance that are contained in electronic waste. The emission/pollution is mainly caused from the primitive techniques such as open burning and open dumping of electronic waste. Open dumping, especially wires and cables, apparently may create persistent organic pollutants (POPs), which may result health effect and diseases of the skin, stomach and other organs. Informal sector plays a significant role in recycling practice. However, after recycling method, most of the leftover material are dumped and burned which create significant potential of health and environmental risks. The effect of improper disposal of electronic waste would observe relatively over a long period of time, which intensify the problem of hazards substances. Electronic waste, that is landfilled, produce contaminated leachates locates which eventually pollute the groundwater and causes acidification in soil. The open burning of plastic causes toxic affect for local environment and global environment. In other hand, incineration also poses threat for environment may emit toxic and harmful gases in the atmosphere.

VI. CONCLUSION

In conclusion, we have found that the electronic waste is one of the main concern in society of developing countries and it's one of the important concept of sustainable development. The volume of electronic waste is growing fast day-by-day because consumer demand of innovative technology is rapidly changing, so, generating massive amount of electronic waste. However, the management practices are poorly designed because lack of awareness in treatment and disposal method and inadequate policies and programs to reduce and manage the waste. The trans-boundary movement of electronic waste is differ in various socioeconomic condition of importing and exporting countries that helps to increase the limited utilization of natural resources. Most developed countries have a lot of success in implementing the EPR policy and program. The best method is knowledge transfer of policy in developing countries to manage their electronic waste problem should be undertaken. EPR policy could play an important role to formalize the strengthening of electronic waste with the initiative of producer take back approach and increase the economic aspects of the country.

NOTE

This work is not related with United Nations work and system.

REFERENCES

- [1] Robinson, B.H. E-waste: An assessment of global production and environmental impacts. *Sci. of the Total Environ.* 408:183-191. (2009).
- [2] Ongondo, F.O. and Williams, I.D. Mobile phone collection, reuse and recycling in the UK. *Waste Management*, 31: 1307-1315. (2011).
- [3] Wath, S.B., Vaidya, A.N., Dutt, P.S., Chakrabarti, T., A roadmap for development of sustainable E-waste management system in India. *Science of the Total Environment* 409, 19-32. (2010).
- [4] Lindqvist, T., Extended Producer Responsibility in Cleaner Production. The International Institute for Industrial Environmental Economics. Lund University, Lund, Sweden. (2000).
- [5] OECD. Extended Producer Responsibility: A Guidance Manual for Governments. OECD, Paris. 2001
- [6] Ogushi, Y., and Kandlikar, M. Assessing extended producer responsibility laws in Japan. *Environmental Science & Technology*, July, 4502-4508. (2007).

- [7] Manamaivibool, P., Network management and environmental effectiveness: the management of end-of-life vehicles in the United Kingdom and in Sweden. *Journal of Cleaner Production*, 16, pp-2006-2017. Doi: 10.1016/j.jclepro.2008.01.013. (2008).
- [8] Matsuto, T., Jung, C.H., and Tanaka, N., Material and heavy metal balance in a recycling facility for home electrical appliances. *Waste Management*, 24: 425-436. (2004).
- [9] Walls, M., Extended producer responsibility and product design. *Resources for the Future*. March. (2006).
- [10] Hicks, C., Dietmar, R. and Eugster, M., The recycling and disposal of electrical and electronic waste in China- legislative and market responses. *Environmental impact Assessment Review*, 25 (5): 459-471. (2005).
- [11] McKerlie, K., Knight, N., and Thorpe, B., Advancing extended producer responsibility in Canada. *Journal of Cleaner Production*, 14 (6): 616-628. (2006).
- [12] Borthakur, A. and Singh, P. Electronic waste in India: Problems and policies. *International Journal of Environmental Sciences*, 3 (1): 353-362. (2012).
- [13] Dwivedy, M., and Mittal, R.K. Future trends in computer waste generation in India. *Waste Management*, 30:2265-2277. (2010).
- [14] Skinner, A., Dinter, Y., Lloyd, A., Strothmann, P. The Challenges of E-Waste Management in India: Can India draw lessons from the EU and the USA? *ASIEN*. 117:7-26. (2010).
- [15] Borthakur, A. and Sinha, K. Generation of electronic waste in India-Current scenario, dilemmas and stakeholders. *African Journal of Environmental Science and Technology*, 7 (9): 899-910, September. (2013).
- [16] Osibanjo, O. and Nnorom, I.C. The challenge of electronic waste (e-waste) management in developing country. *Waste Management and Research*, 25: 489-501. (2007).
- [17] Toxic Link E-waste in India: System failure imminent-take action Now! Available at www.toxiclink.org/docs/06040_repsumry.pdf. Last accessed on 4th March 2015. (2004).
- [18] Cui, J.R., and Zhang, L.F. Metallurgical recovery of metals from electronic waste: a review. *Journal of Hazardous Material*, 158:228-256. (2008).
- [19] Leung A., Cai, Z.W., and Wong M. H. Environmental contamination from electronic-waste recycling at Guiyu South-east China. In *Proceedings of The Third Workshop on Material Cycles and Waste Management in Asia (NIES E-waste Workshop)*, December 14-15, NIES, Tsukuba, Japan. (2004).

AUTHORS

Correspondence Author – Anupam Khajuria, Ph.D. of Environmental Engineering, Researcher, United Nations Centre for Regional Development. E-mail: khajuriaanu@gmail.com

Effect of Seed Powder of Three Pepper Species on the Bionomics of Cowpea Bruchid, *Callosobruchus maculatus* Fabricius

Onekutu, A, Nwosu, L. C. and Nnolim, N. C.

Department of Biological Sciences, University of Agriculture, P.M.B. 2373, Makurdi, Benue State, Nigeria

Abstract- Seed powder of *Afromomum melegueta*, *Piper guineense* and *Xylopiia aethiopica* at the rates of 0.5, 1.0 and 1.5 g/ 20 g seeds of cowpea were assessed for insecticidal activities against *Callosobruchus maculatus* Fabricius in the laboratory under fluctuating ambient temperature and relative humidity in Makurdi, Benue State, Nigeria. *P. guineense* caused the highest toxicity (68.53%) at 1.5 g/ 20 g cowpea seeds after 96 hours of exposure. Oviposition deterrency, larvicidal effect and suppression of adult emergence recorded for *P. guineense* was considerable but failed to match the conventional synthetic insecticide, Permethrin ($P > 0.05$). *A. melegueta* at test concentrations and at short storage duration (< 5 days) was not toxic to the bruchid. However, it significantly ($P < 0.05$) deterred oviposition in *C. maculatus* females when compared to unprotected cowpea seeds. In the study, *X. aethiopica* protected cowpea seeds better than *A. fromomum* and gave minimal support to the bionomics of the bruchid. The study seriously suggests an increased need for search for botanical insecticides that can effectively control the resistant cowpea bruchid. Any natural material that cannot give good control of *C. maculatus* at an economically justified concentration in 24 hours may not be sustainable.

Index Terms- *Afromomum melegueta*, *Piper guineense*, *Xylopiia aethiopica*, Oviposition deterrency

I. INTRODUCTION

Cowpea, *Vigna unguiculata* (L.) Walp is an important legume crop of Africa (Agboola, 1997). Nigeria accounts for 70 % of the world's cowpea production (Blade *et al.*, 1997). Cowpea seeds are rich in protein and amino acids and therefore serve as a valuable source of protein for human consumption (Quin, 1997; Somta *et al.*, 2008). In addition, the crop is a source of livestock feed in the tropics (Adedire and Lajide, 1999) and a source of revenue (Alghali, 1991).

It is attacked by a number of field and post harvest pests with *C. maculatus* (Coleoptera: Bruchidae) ranked as the most notorious post harvest pest (Caswell and Akibu, 1980). Damage and loss in stored cowpea due to *C. maculatus* infestation is a very serious problem to farmers and traders (Rees, 2004). Infestation culminates in substantial reduction in the quantity and quality of seed. Damaged cowpea seeds are unsuitable for human consumption and cannot be effectively used for agricultural and commercial purposes (Somta *et al.*, 2008).

Synthetic insecticides have for been used to effectively control cowpea bruchids (Somta *et al.*, 2008). However, economic, health and environmental implications has necessitated reorientation of research focus to the development of alternative control agents that are relatively cheap, easy to apply, safe and eco-friendly (Adedire and Lajide, 1999). Already, plant materials have been investigated for *C. maculatus* management in stored cowpea and some of the results are encouraging (Adedire and Lajide, 1999; Sarfraz and Keddie, 2005).

Among plant species so far investigated for contact toxicity against bruchids' and weevils' infestations in stored grains, the peppers seem to hold very strong promise (Asawalam and Emosiarue, 2006; Babarinde *et al.*, 2008). Therefore, the present study sought to assess the effect of seed powders of three indigenous pepper plants on the toxicity and reproductive fitness of *C. maculatus* infesting stored cowpea.

II. MATERIALS AND METHODS

Insect Culture

Adult *Callosobruchus maculatus* used to establish the culture were obtained from naturally infested cowpea seeds procured from North Bank Market, Makurdi Benue State, Nigeria. The bruchids were mass reared on the susceptible local variety, Sokoto white under fluctuating ambient temperature and relative humidity. Newly emerged adult bruchids (1 – 2 days old) were used for the experiment.

Pepper Species and Powder Preparation

The three pepper species tested were *Afromomum melegueta* Schum (alligator pepper), *Piper guineense* Schum (black pepper) and *Xylopiia aethiopica* Dunal (Ethiopian pepper). These species belong to families Zingiberaceae, Piperaceae and Annonaceae respectively. Five grams each of dried seeds of the pepper species were separately ground into powder and used immediately for the bioassays.

Bioassays

Twenty grams of disinfested and standardized (using the method of Sulehrie *et al.*, 2003) cowpea variety, IFE BROWN were separately weighed into thirteen highly transparent plastic containers. The first three containers were added sequentially 0.5, 1.0 and 1.5 g of *A. melegueta* seed powder. The fourth, fifth and sixth containers received sequentially 0.5 1.0 and 1.5 g of seed powder of *P. guineense* while the seventh, eighth and ninth containers were added 0.5, 1.0 and 1.5 g of *X. aethiopica* respectively. The tenth, eleventh and twelfth containers received 0.5, 1.0 and 1.5 g of permethrin insecticide (Rambo: 0.6 %

permethrin) respectively. The thirteenth container received no treatment and served as an untreated control. Cowpea seeds were vigorously shaken for adequate mixing with pepper powders and allowed for 15 minutes (Southgate *et al.*, 1957) before the introduction of five pairs of freshly emerged male and female adult *C. maculatus* into each container. The containers were covered with muslin cloth (fixed with cut-edge of container lid) for aeration and to prevent exist of the bruchids and entry of unwanted organisms. Each set-up was replicated four times and arranged in completely randomized block design on a laboratory bench at fluctuating ambient temperature and relative humidity. Adult mortality was assessed daily up to 96 hours and the number of dead bruchids was converted to percent mortality.

Six days after treatment with pepper species and synthetic insecticides, all dead (those that did not respond to probe with a pin) and live adult bruchids were removed and discarded. The number of eggs laid in a no choice condition was recorded. Egg count was done on ten randomly selected seeds. Cowpea seeds with hatched eggs/ larvae were examined and recorded and adult emergence was recorded beginning 21 days after oviposition until there was no emergence for three consecutive days (Sulehrie *et al.*, 2003).

Statistical Analysis

Table 1: Comparative Contact Toxicity of Seed Powder of Three Pepper Species against Adult *Callosobruchus maculatus* Fabricius

Treatment	Rate (g/20 g seeds)		% Mortality at indicated hour*			
	48	72	96			
<i>A. melegueta</i>	0.5	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a
	1.0	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a
	1.5	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a
<i>P. guineense</i>	0.5	3.33±4.72a	16.66±7.50b	33.33±6.10b	50.00±3.30b	
	1.0	10.00±2.30b	28.25±4.74b	19.00±3.80b	58.24±7.00b	
	1.5	18.69±2.80b	37.20±1.00b	60.00±0.50b	68.53±0.10b	
<i>X. aethiopica</i>	0.5	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a
	1.0	0.00±0.00a	0.00±0.00a	0.00±0.00a	2.50±2.50a	
	1.5	1.21±0.10a	4.00±0.10a	6.66±0.20a	7.48±0.21a	
Permethrin	0.5	100.00±0.00b	100.00±0.00c	100.00±0.00c	100.00±0.00c	100.00±0.00c
	1.0	100.00±0.00c	100.00±0.00c	100.00±0.00c	100.00±0.00c	100.00±0.00c
	1.5	100.00±0.00c	100.00±0.00c	100.00±0.00c	100.00±0.00c	100.00±0.00c
Untreated Control	0.0	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a

* All values are means of four replicates followed by standard error of the means. Means of the four treatments were compared same test concentration by same test concentration. Means followed by the same letter are not significantly different (P> 0.05) by Fischer’s Least Significant Difference (Multiple range test).

Table 2 presents the results of comparative effect of seed powder of three pepper species on oviposition of adult female *C. maculatus* after six days of exposure. Similarly, variations were

Data were subjected to analysis of variance (ANOVA) using SPSS statistic 17.0 software. Mean separation was done using new multiple range test (FLSD) as 5 % level of probability.

III. RESULTS

Table1 presents the results of toxicity of seed powder of three pepper species compared to permethrin against adult *C. maculatus*. The results showed that mortality of the cowpea bruchid varied among treatments as well as within rates of a particular pepper species. Adult mortality also varied with post treatment period. There was no contact toxicity on adult bruchids with *A. melegueta* at all tested rates over short storage duration (< 5 days). Among the pepper species, seed powder of *P. guineense* was the most toxic to the bruchid, killing over 50 % in 96 hours at all tested rates, followed by *X. aethiopica* (when compared with results from untreated control). However, over short duration of exposure, no pepper seed powder matched the efficacy of the synthetic insecticide in killing the bruchids (P > 0.05). Only the seed powder of *P. guineense* was half-as-effective as permethrin.

recorded in the mean number of eggs laid by the cowpea bruchid amidst pepper treatments as well as within tested rates of a particular pepper. Oviposition deterrence among pepper species increased with treatment rate. Eggs were not laid on cowpea seeds protected with permethrin in six days. On the contrary, unprotected seeds (in a sample of ten) had about 162 eggs. The most effective pepper seed powder for oviposition deterrence against gravid *C. maculatus* was *P. guineense*. Among the pepper species tested, highest number of eggs was laid on cowpea seeds treated with *A. melegueta*.

Table 2: Comparative Effect of Seed Powder of Three Pepper Species on Oviposition of Female *Callosobruchus maculatus* Fabricius in a No choice Condition

Treatment	Rate (g/20 g seeds)	(n** = 10)	Number of Eggs Laid*
<i>A. melegueta</i>	0.5		45.00±1.50a
	1.0		44.00±0.95a
	1.5		40.23±3.34a
<i>P. guineense</i>	0.5		33.67±6.32a
	1.0		25.00±7.50b
	1.5		14.33±0.23b
<i>X. aethiopica</i>	0.5		41.67±10.42a
	1.0		27.00±5.27b
	1.5		16.33±4.05b
Permethrin	0.5		0.00±0.00b
	1.0	0.00±0.00d	
	1.5	0.00±0.00d	
Untreated Control	0.0		161.67±2.50c

* All values are means of four replicates followed by standard error of the means. Means of the four treatments were compared same test concentration by same test concentration. Means followed by the same letter are not significantly different ($P > 0.05$) by Fischer's Least Significant Difference (Multiple rang test).

**Number of randomly selected cowpea seeds for oviposition assessment.

Table 3 presents the larvicidal effect of seed powder of three pepper species on *C. maculatus*. Variations were recorded in the number of hatched larvae among pepper treatments and also within test concentrations of a particular species. *P. guineense* produced the highest larvicidal effect among the pepper species, but did not show any clear pattern with advancing concentration. More larvae hatched in cowpea seeds

treated with seed powder of *X. aethiopica* than in seeds protected with *A. melegueta* seed powder. No larvae hatched in seeds treated with permethrin insecticide. Unprotected cowpea seeds had about three hatched larvae and this matched ($P > 0.05$) the number that hatched in seeds protected with *X. aethiopica* at a concentration of 0.5 g /20 g seeds (2.5 % w/w).

Table 3: Larvicidal Effect of Seed Powder of Three Pepper Species on *Callosobruchus maculatus* Fabricius

Treatment	Rate (g /20 g seeds)	Mean number of Larvae* (in 10 sampled seeds)
<i>A. melegueta</i>	0.5	2.09±0.30a
	1.0	1.80±0.27a
	1.5	0.90±0.22a
<i>P. guineense</i>	0.5	0.90±0.25b
	1.0	1.29±0.29a
	1.5	1.00±0.23a
<i>X. aethiopica</i>	0.5	2.57±0.44a
	1.0	2.24±0.31b
	1.5	1.76±0.29a
Permethrin	0.5	0.00±0.00c
	1.0	0.00±0.00c
	1.5	0.00±0.00c
Untreated Control	0.0	2.92±2.24a

*All values are means of four replicates followed by standard error of the means. Means of the four treatments were compared same test concentration by same test concentration. Means followed by the same letter are not significantly different ($P > 0.05$) by Fischer's Least Significant Difference (Multiple rang test).

Table 4 presents the result of adult emergence from cowpea seeds as influenced by different treatments and concentrations. Even though, the least number of bruchids emerged from the

conventional synthetic insecticide, permethrin, *P. guineense* was best in suppressing *C. maculatus* adult emergence among the test pepper species. Seed powder of *X. aethiopica* reduced adult emergence more than *A. melegueta*. At the rate of 0.5 g /20 g seeds, *A. melegueta* did not significantly differ ($P > 0.05$) from number of emerged bruchids in unprotected cowpea seeds. The number of emerged bruchids reduced with higher proportion of the treatments. Permethrin was about 35 % better than *P. guineense* in suppressing *C. maculatus* adult emergence.

Table 4: Adult Emergence of *Callosobruchus maculatus* Fabricius from Cowpea Seeds Treated with Seed Powder of Three Pepper Species and Synthetic Insecticide

Treatment	Rate (g /20 g seeds)	Mean number of Emerged Adults*
<i>A. melegueta</i>	0.5	63.00±0.22a
	1.0	54.00±0.53be
	1.5	50.00±0.60a
<i>P. guineense</i>	0.5	27.00±0.10b
	1.0	20.00±0.00c
	1.5	19.00±0.72b
<i>X. aethiopica</i>	0.5	48.00±3.20c
	1.0	43.00±7.61e
	1.5	40.00±6.73a
Permethrin	0.5	8.00±0.95d
	1.0	6.00±1.23d
	1.5	4.00±0.78c
Untreated Control	0.0	65.00±0.12ab

*All values are means of four replicates followed by standard error of the means. Means of the four treatments were compared same test concentration by same test concentration. Means followed by the same letter are not significantly different ($P > 0.05$) by Fischer's Least Significant Difference (Multiple rang test).

IV. DISCUSSION

The result of this study indicates that seed powder of *Piper guineense* showed the highest insecticidal activity against *Callosobruchus maculatus*. After 24 hours of exposure, its toxic effect generally became noticeable and considerable from 72 hours of exposure (at 1.5 g/ 20 g cowpea seeds) when compared to permethrin. *P. guineense* larvicidal effect and ability to suppress bruchid adult emergence were considerable when compared to the conventional synthetic insecticide, permethrin. This agrees with the conclusion that members of the family Piperaceae show some form of insecticidal activity (Adedire and Ajayi, 1996; Adedire and Lajide, 1999; Asawalam *et al.*, 2006). Okonkwo and Okoye (1996) reported that the bioactive chemicals in *P. guineense* are piperine and chavicine and these are highly insecticidal to various crop pests. Lale (1995) however considers piperidine and alkaloids as the major active ingredients in *P. guineense* seeds. However, the plant's seed powder failed to match oviposition deterrence exhibited by permethrin.

That *Afromomum melegueta* did not show contact toxicity against *C. maculatus* at short storage duration corroborates the

findings of Adedire and Lajide (1999). However, seed extracts of the plant in particular have been shown to be toxic to bruchids and some other stored product pests (Escoubas *et al.*, 1995; Lale, 2002; Ntonifor *et al.*, 2010). Adedire and Lajide (1999) and Lale (2002) reported paradol, an alkyl phenol as the major insecticidal constituent of *A. melegueta*. The plant significantly deterred oviposition when compared to the unprotected cowpea seeds but not when compared to permethrin. Ofuya (1990) had reported that both seed powder and extract of *A. melegueta* did not significantly affect oviposition and egg hatchability of *C. maculatus*.

Xylopiya aethiopica did not show any considerable oviposition deterrence effect when compared with unprotected cowpea seeds. However, it significantly reduced adult fecundity and increased adult mortality of *Sitophilus zeamais* on partially resistant stored maize (Babarinde *et al.*, 2008).

Contact and fumigant activities might be responsible for the obtained results as reported by (Asawalam *et al* 2007; Tchoumboungang *et al.*, 2009; Ukeh *et al.*, 2010; Ntonifor and Mona, 2011). It is interesting that *P. guineense* that most effectively protected against bruchid infestation is edible and as such poses no risk to the health of man and the environment.

More importantly, the results of this study strongly suggest an increased need to research rapidly for plant derived insecticides that will control the notorious *C. maculatus* in stored cowpea.

REFERENCES

- [1] Adedire, C.O. and Ajayi, T.S. (1996). Assessment of the insecticidal properties of some plants extracts as grain protectants against the maize weevil *S. zeamais* Motschulsky. Nigerian Journal of Entomology 13: 93-101.
- [2] Adedire, C.O. and Lajide, L. (1999). Toxicity and oviposition deterrence of some plants extracts on cowpea storage bruchid, *Callosobruchus maculatus* Fabricius Journal of Plant Diseases and Protection 106: 647-653.
- [3] Alghali, A.M. (1991). Studies on cowpea farming practices in Nigeria, with the emphasis on insect pest control. Tropical Pest Management 37: 71-74.
- [4] Asawalam, E.F. and Emosairue, S.O. (2006). Comparative efficacy of Piper guineense (Schum and Thorn) and pirimiphos methyl as poisons against *Sitophilus zeamais* (Motsch.). Electron Journal of Environmental and Agricultural Food Chemistry 5: 1536-1545.
- [5] Babarinde, S.A., Adebayo, A.A. and Oduyemi, K. (2008). Integrating varietal resistance with *Xylopi aethiopia* (Dunal) seed extract for the management of *Sitophilus zeamais* Motschulsky in stored maize. African Journal of Biotechnology 7: 1187-1191.
- [6] Caswell, G.H. and Akibu, S. (1980). The use of pirimiphos-methyl to control bruchids attacking selected varieties of stored cowpea. Tropical Grain Legume Bulletin 17/18: 9-11.
- [7] Lale, N. E.S. (1995). Laboratory study of comparative toxicity of products from three spices of maize weevil. Postharvest Biology and Technology 2: 51-64.
- [8] Lale, N.E.S. (2002). Stored Product Entomology and Acarology in Tropical Africa. 1st Edn. Mole Publication, Maiduguri, p. 204.
- [9] Ntonifor, N.N., Brown, R.H. and Muller-Harvey, I. (2010). Extracts of tropical African spices are active against *Plutella xylostella*. Journal of Food and Agricultural Environment 8: 16-26.
- [10] Ofuya, T.I. (1990). Oviposition deterrence and ovicidal properties of some plant powders against *Callosobruchus maculatus* in stored cowpea (*Vigna unguiculata*) seed. during storage. Agricultural Science Cambridge 115: 343-345.
- [11] Okonkwo, E.O. and Okoye, W.I. (1996). The efficacy of four seed powders and essential oils as protectant of cowpea and maize grains against infestation *Callosobruchus maculatus* (Fabricius) (Coleoptera: Curculionidae) in Nigeria. International Journal of Pest Management 42: 143-146.
- [12] Quin, F.M. (1997). Introduction. In: Singh, B.B., D.R. Mohan Raj, K.E. Dashiell, K.E., L.E.N. Jackai (eds.): Advances in Cowpea Research. Copublication of International Institute of Tropical Agriculture (IITA) and Japan International Research Center for Agricultural Sciences, pp. ix-xv.
- [13] Rees, D. (2004). Insects of stored products. CSIRO Publishing, Canberra, Australia.
- [14] Sarfraz, M. and Keddie, B.A. (2005). Conserving efficacy of insecticides against *Plutella xylostella* (L.) (Lepidoptera: Plutellidae). Journal of Applied Entomology 129: 149-157.
- [15] Somta, C, Somta, P., Tomooka, N., Ooi, P.A.C., Vaughan D.A. and Srinivies, P. (2008). Characterization of new sources of mungbean (*Vigna radiata* (L.) Wilczek) resistance to bruchids, *Callosobruchus* spp.(Coleoptera: Bruchidae). Journal of Stored Products Research 44: 316-321.
- [16] Tchoumboungang, F.J., Dogmo, P.M., Sameze, M.L., Ndifor, F., Wouatsa, N.A.V., Zoll, P.M.A. and Menut, C. (2009). Comparative essential oils composition and insecticidal effect of different tissues of *Piper capense* (L.), *Piper guineense* Schum Thorn, *Piper nigrum* L. and *Piper umbellatum* L. grown in Cameroon. African Journal of Biotechnology 8: 424-431.
- [17] Ukeh, D.A., Birkett, M.A., Bruce, T.J., Allan, E.J., Pickett, J.A. and Luntz, A.J. (2010). Behavioural responses of the maize weevil *Sitophilus zeamais* to host (stored grain) and non-host plant volatiles. Pest Management Science 66: 44-50.

AUTHORS

First Author – Onekutu, A, Department of Biological Sciences, University of Agriculture, P.M.B. 2373, Makurdi, Benue State, Nigeria, e-mail: aonekutu2002@yahoo.com

Second Author – Nwosu, L. C, Department of Biological Sciences, University of Agriculture, P.M.B. 2373, Makurdi, Benue State, Nigeria

Third Author – Nnolim, N. C. Department of Biological Sciences, University of Agriculture, P.M.B. 2373, Makurdi, Benue State, Nigeria

4 – Element Spatial Power Combiner for High Frequency Communication Systems

¹M.H. Ali and ²S. Muhammad

¹Department of Physics, Bayero University Kano, Kano, Nigeria

²Department of Physics, Ibrahim Babangida University Lapai, Niger State, Nigeria.

Abstract- A solution to the insertion loss in the Distributed Amplifier configuration is presented. Wilkinson power splitter is employed at the input and wave interference characteristic is considered as the means of combining the transmitted power from active antennas. The overall result of using the power splitter and spatial combination of the signals is found to enhance the strength of the transmitted power by a factor of 16. More gain could be achieved by adding more power splitters and the corresponding active antennas.

Index Terms- Wilkinson Power Divider/Combiner, Distributed Amplifier, Cascode Amplifier, Antenna Array.

I. INTRODUCTION

The rapid development of wireless communication system increased the demand for circuits with very high gain and wide bandwidth for efficient data rate transfer (Kushwaha and Srivastava, 2013). As the data rate in communication system increases such as backhaul unit, corresponding increase in the output power of the signals radiated by a tower-mounted antenna is typically required by a given service area. Thus, migrating an existing system to a higher data rate often requires more output power from the amplifier used in the system and or a reduction of losses associated with components in the system (Yerraw, 2012). Amplifying devices have inherent limitation of gain-bandwidth products which forced one to compromise the gain at the expense of the bandwidth or vice versa (Philip *et al*, 2000). Philip *et al*, (2000) and Wolf *et al*, (2005) proposed and used Distributed amplifier configuration as one of the solution to the gain bandwidth bottleneck. The distributed amplifier divides the power from a single input to several amplifiers through the use of transmission line. It is evident that, as additional amplifiers are combined, the transmission line length and circuit complexity increase (Harvey *et al*, 2000). Furthermore, as the length increase to add more devices, insertion losses in the transmission lines

grow to the extent of eventually exceeding the gain from the amplifiers (Harvey *et al*, 2000). In addition, large current signal is normally realized towards the output of the last stage in the output transmission line. This large current also heat up the circuit board (Ali and Dambatta, 2000). This work proposes the addition of the signal to be carried out in space instead of in the circuitry and thus avoid the problem of heating the circuit and the corresponding signal losses.

II. METHODOLOGY

The method used is in three stages. Firstly, the power to be amplified will be split into 4 smaller equal parts using Wilkinson power splitters. In the second stage, four high gain broadband amplifiers were used to amplify the split power and finally, the amplified signals are transmitted into space through four equally spaced antennas. At any receiving point, there would be four signals combining to form the final received signal from each of the four antennas.

1.1 Design of the Corporate Feed

The use of three – port power dividers is especially important for antenna array that utilize a power splitting network. The corporate feed is simply a device that splits power between n-outputs with a certain distribution while maintaining equal path length from input to output ports. The array feeding network is a corporate feed type utilizing equal split of the convectional Wilkinson power divider in resistive form with a unique topology (Daniel and Harley, 2010).

Wilkinson describes a device that separated one signal into equal signals of equal phase and amplitude. The in-phase power combiners and dividers are important components of RF and microwave transmitter where it is necessary to deliver a high level of the output power to antenna, especially in array (Abdul-Raheem, 2010). The diagram below shows a Wilkinson splitter.

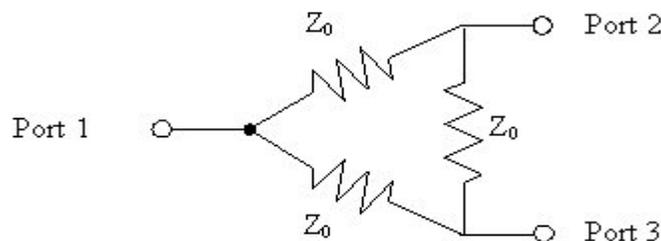


Fig. 1: Wilkinson splitter

Where Z_0 are the resistive value in this case.

1.2 Design of Amplifier

1.3

A very wide band amplifier stage with appreciable gain is used. It is called a Cascode amplifier (Sedra and Smith, 2004) and (Dogman and Jenkin, 2010). Its design is presented below.

In the design, the same transistors were used in the common emitter and common base stage, hence $\beta_{F1} = \beta_{F2} = \beta_F \gg 1$, that is the base current of the transistors is negligible, and base current can be ignored in comparison to the currents through the biasing resistances. Fig. 2 below shows the schematic diagram of a Cascode amplifier. The DC biasing base voltages are given by

$$V_{BB1} = \frac{R_1}{R_1 + R_2 + R_3} V_{CC} \quad (1)$$

$$V_{BB2} = \frac{R_1 + R_2}{R_1 + R_2 + R_3} V_{CC} \quad (2)$$

The Collector and emitter currents are given by,

$$I_{E1} \cong I_{C1} = I_{E2} \cong I_{C2} = \frac{V_{BB1} - V_{BE}}{R_E} \quad (3)$$

The collector emitter voltages are given by

$$V_{CE1} = V_{BB2} - V_{BE2} - (V_{BB1} - V_{BE1}) \quad (4)$$

$$V_{CE2} = V_{BB2} - R_C I_{C2} - (V_{BB2} - V_{BE2}) \quad (5)$$

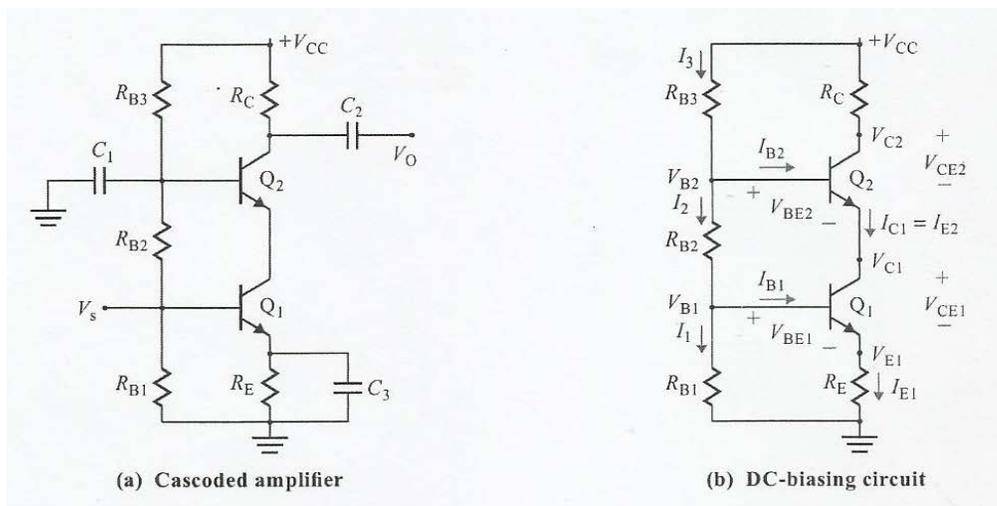


Figure 2: Cascode amplifier (Rashid, 2011).

1.4 High Frequency Hybrid- π Model of Cascode Amplifier

The analysis result was obtained by replacing the transistors in the circuits above with the high frequency Hybrid- π Model of the Cascode amplifier. Fig. 3 shows the high frequency Cascode amplifier neglecting r_x and r_o . We have the small signal equivalent circuit of the configurations as shown in Fig. 4.

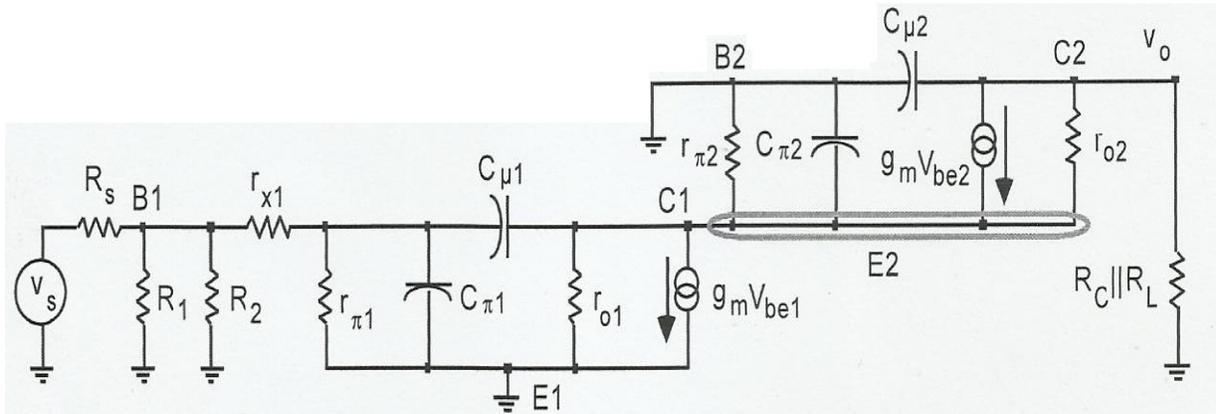


Fig. 3: High frequency equivalent circuit of Cascode amplifier (Sedra and Smith, 2004)

where;

r_{x1} = Ohmic base spreading resistance, g_m = Transistor transconductance

$r_{\pi 1} = r_{\pi 2}$ = Base emitter impedance resistance, $C_{\pi 1} = C_{\pi 2}$ = Dynamic emitter capacitance

$r_{o1} = r_{o2}$ = Output resistance, $C_{\mu 1} = C_{\mu 2}$ = Collector junction barrier capacitance

$V_{be1} = V_{be2}$ = Base emitter voltage, R_C = Collector resistance, R_L = Load resistance

R_S = Source resistance, R_1 = Bias resistor one, R_2 = Bias resistor two

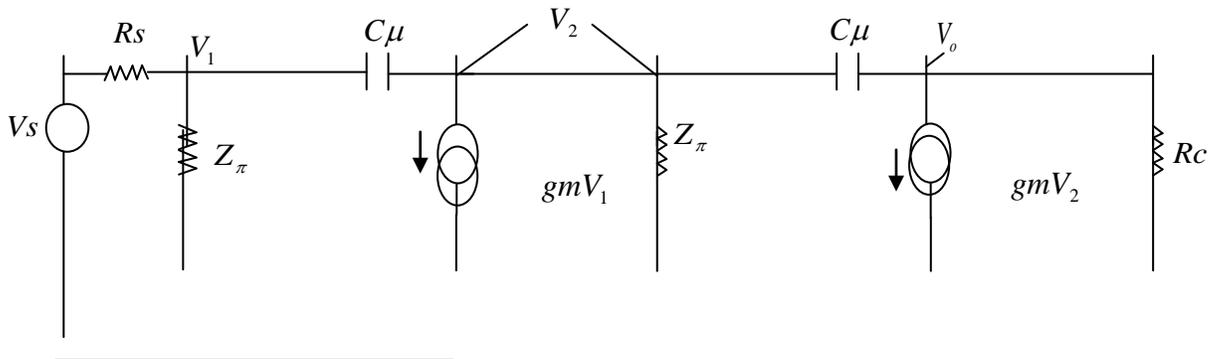


Fig. 4: High frequency Cascode hybrid π model

Where, Z_{π} is the parallel combination of r_{π} and c_{π} , $V_1 = V_{be1}$, $V_2 = V_{be2}$

Nodal equations

At V_1 we have

$$\frac{V_1 - V_s}{R_s} + \frac{V_1}{Z_{\pi}} + \frac{V_1 - V_2}{X_{cu}} = 0 \tag{6}$$

at V_2 we have

$$\frac{V_2 - V_1}{X_{Cu}} + gmV_1 + \frac{V_2}{Z_{\pi}} + \frac{V_2 - V_0}{X_{Cu}} = 0 \tag{7}$$

at V_0 we have

$$\frac{V_0 - V_2}{X_{Cu}} + gmV_2 + \frac{V_0}{R_C} = 0 \tag{8}$$

using equations (6) through (8), we have the transfer function (A_v) , $\frac{V_o}{V_s}$ as

$$A_v = \frac{V_o}{V_s} = \frac{G_s(r_\pi SC_u - gm r_\pi)(SC_u - gm)}{[SC_\mu + G_c][2r_\pi SC_\mu + SC_\pi r_\pi + 1] - r_\pi SC_\mu [SC_\mu - gm][r_\pi G_s + 1 + SC_\mu r_\pi + SC_\pi r_\pi + 1] - [SC_\mu + G_c][r_\pi SC_\mu - gm r_\pi](SC_\mu r_\pi)} \tag{9}$$

1.5 The antenna Array

The amplifier output is being feed to an antenna. The advantage of this active antenna is to amplify the signal before transmission into space. Constructive interference is used to enhance the beam of the 4 – element active antenna on a given direction (Jenkins and White, 1957).The antennas are placed along a line; the axis of the array. A $\frac{\lambda}{2}$ spacing is used in order to have end-fire pattern illustrated in Figure 11.

If the amplitude of the four waves are $a_1, a_2, a_3,$ and $a_4,$ we may write the separate displacement as follows:

$$\left. \begin{aligned} y_1 &= a_1 \sin(\omega t - \alpha_1) \\ y_2 &= a_2 \sin(\omega t - \alpha_2) \\ y_3 &= a_3 \sin(\omega t - \alpha_3) \\ y_4 &= a_4 \sin(\omega t - \alpha_4) \end{aligned} \right\} \tag{10}$$

ω is the same for all the waves. According to the principle of superposition, the resultant displacement y is merely the sum of y_1, y_2, y_3 and y_4 and we have

$$y = a_1 \sin(\omega t - \alpha_1) + a_2 \sin(\omega t - \alpha_2) + a_3 \sin(\omega t - \alpha_3) + a_4 \sin(\omega t - \alpha_4) \tag{11}$$

Using the expression for the sine of the difference of two angles we have

$$y = (a_1 \cos \alpha_1 + a_2 \cos \alpha_2 + a_3 \cos \alpha_3 + a_4 \cos \alpha_4) \sin \omega t - (a_1 \sin \alpha_1 + a_2 \sin \alpha_2 + a_3 \sin \alpha_3 + a_4 \sin \alpha_4) \cos \omega t \tag{12}$$

Since the a 's and α 's are Constance, we are justified in setting

$$a_1 \cos \alpha_1 + a_2 \cos \alpha_2 + a_3 \cos \alpha_3 + a_4 \cos \alpha_4 = A \cos \theta. \tag{13}$$

$$a_1 \sin \alpha_1 + a_2 \sin \alpha_2 + a_3 \sin \alpha_3 + a_4 \sin \alpha_4 = A \sin \theta \tag{14}$$

Squaring and adding both equation 13 and 14 we have

$$\begin{aligned} A^2(\cos^2 \theta + \sin^2 \theta) &= a_1^2(\cos^2 \alpha_1 + \sin^2 \alpha_1) + a_2^2(\cos^2 \alpha_2 + \sin^2 \alpha_2) + \\ &+ a_3^2(\cos^2 \alpha_3 + \sin^2 \alpha_3) + a_4^2(\cos^2 \alpha_4 + \sin^2 \alpha_4) + 2a_1 a_2 \cos(\alpha_1 - \alpha_2) + \\ &+ 2a_1 a_3 \cos(\alpha_1 - \alpha_3) + 2a_1 a_4 \cos(\alpha_1 - \alpha_4) + 2a_2 a_3 \cos(\alpha_2 - \alpha_3) + \\ &+ 2a_2 a_4 \cos(\alpha_2 - \alpha_4) + 2a_3 a_4 \cos(\alpha_3 - \alpha_4). \end{aligned} \tag{15}$$

The schematic diagram of the spatial power combined system is shown in Figure 5. The time average power transmitted across a closed surface s is given by the integral of the real part of one half, the normal component of the complex Pointing vector $\mathbf{E} \times \mathbf{H}^*$ (Kraus, 1988).

$$P = \text{Re} \int_{1/2} \oint s \mathbf{E} \times \mathbf{H}^* . ds \tag{16}$$

Where E and H are the peak values of the fields.

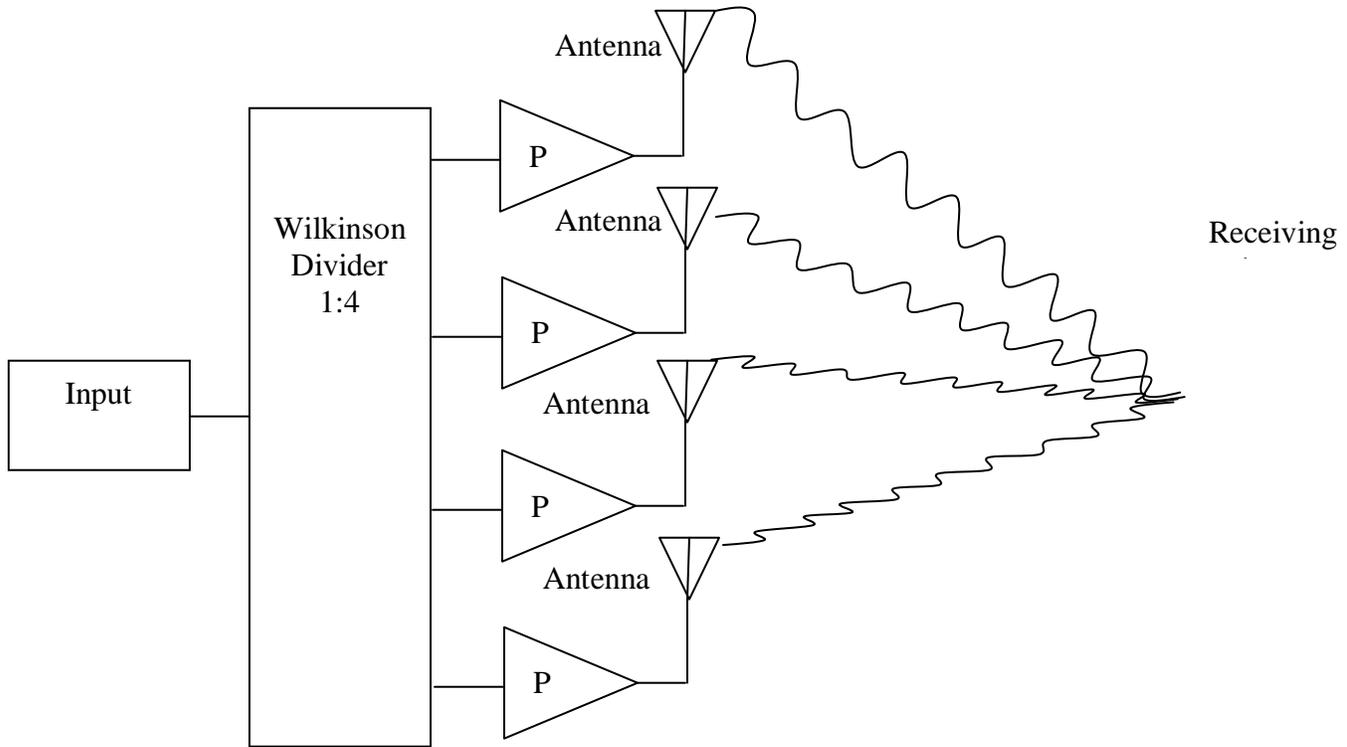


Fig. 5: Schematic diagram of spatial power combiner

III. RESULTS

The Wilkinson divider was designed using resistive splitter for its simplicity being made up from only resistor. A Delta format of power divider was utilized to design a 2:1 divider. A 4:1 power divider was formed by cascading two outputs of a single Wilkinson power divider as shown in Fig. 6 and 7 below.

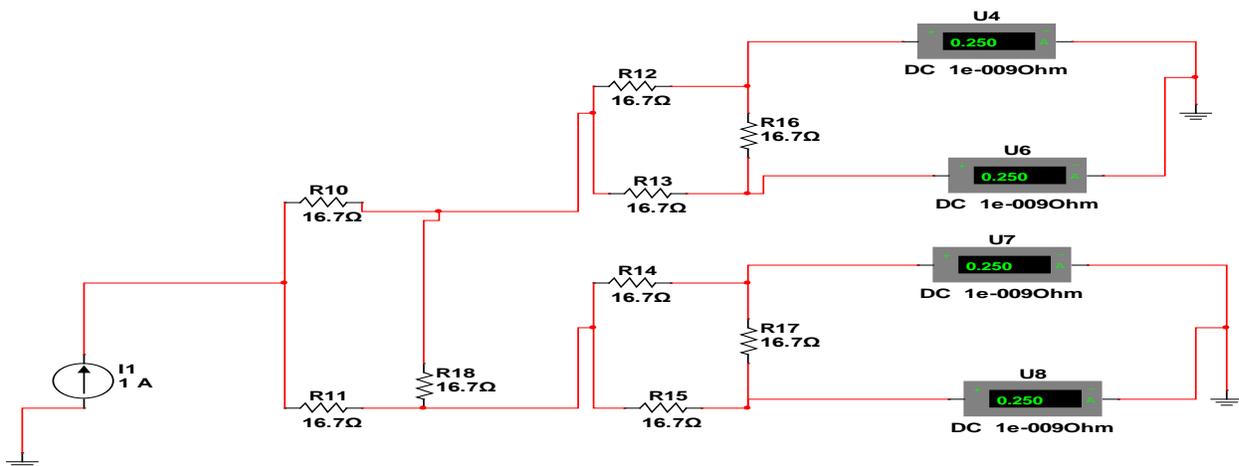


Fig. 6: Four way Wilkinson divider (Current division)

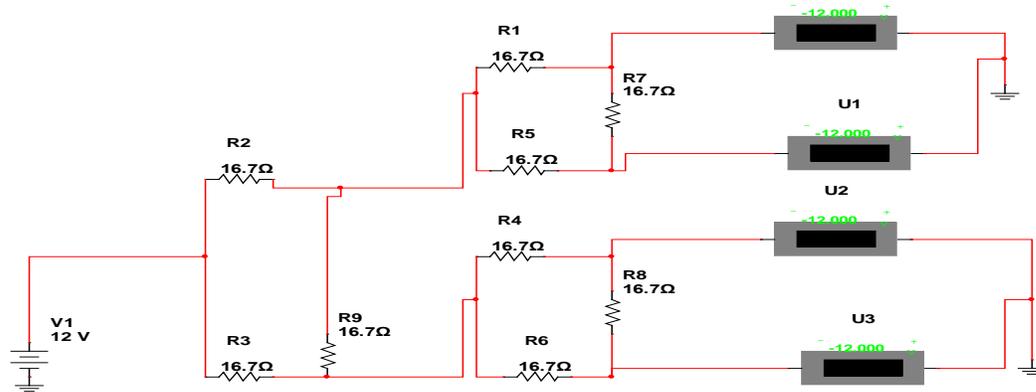


Fig. 7: Four ways Wilkinson divider (Constant voltage)

3.1 Amplifier

The simulated and calculated result of the amplifiers configuration is shown. The gain for the simulation was obtained from the plot of voltage gain against frequency, while that of the analysis were obtained from equation 9 of the Cascode amplifier. And the graphs for the simulation and analysis are shown in Figures 8 and 9 below.

The values of the component used in the design are shown below.

$$R_B = 5.6112 \times 10^3 \Omega, \quad R_1 = 30.0 \text{ ka}, \quad R_2 = 6.90 \times 10^3 \Omega$$

$$R_C = 1.34 \times 10^3 \Omega, \quad R_E = 267.22 \Omega, \quad C_b = 141 \text{ pf}, \quad C_c = 60 \text{ pf}, \quad C_e = 3 \text{ nf}$$

$$C_\pi = 0.15 \text{ pf}, \quad C_\mu = 0.55 \text{ pf}, \quad \beta = 70, \quad g_m = 0.112, \quad r_\pi = 6252 \Omega$$

$$G_C = 0.00075 \Omega, \quad G_S = 0.000182 \Omega$$

When these values are used, the transfer function of equation (9) becomes

$$A_V(S) = \frac{1.418 \times 10^{-25} S^2 - 5.775 \times 10^{-14} S + 5.88 \times 10^{-3}}{4.028 \times 10^{-23} S^2 - 2.844 \times 10^{-21} S^2 - 2.319 \times 10^{-11} S + 8.344 \times 10^{-4}} \quad (17)$$

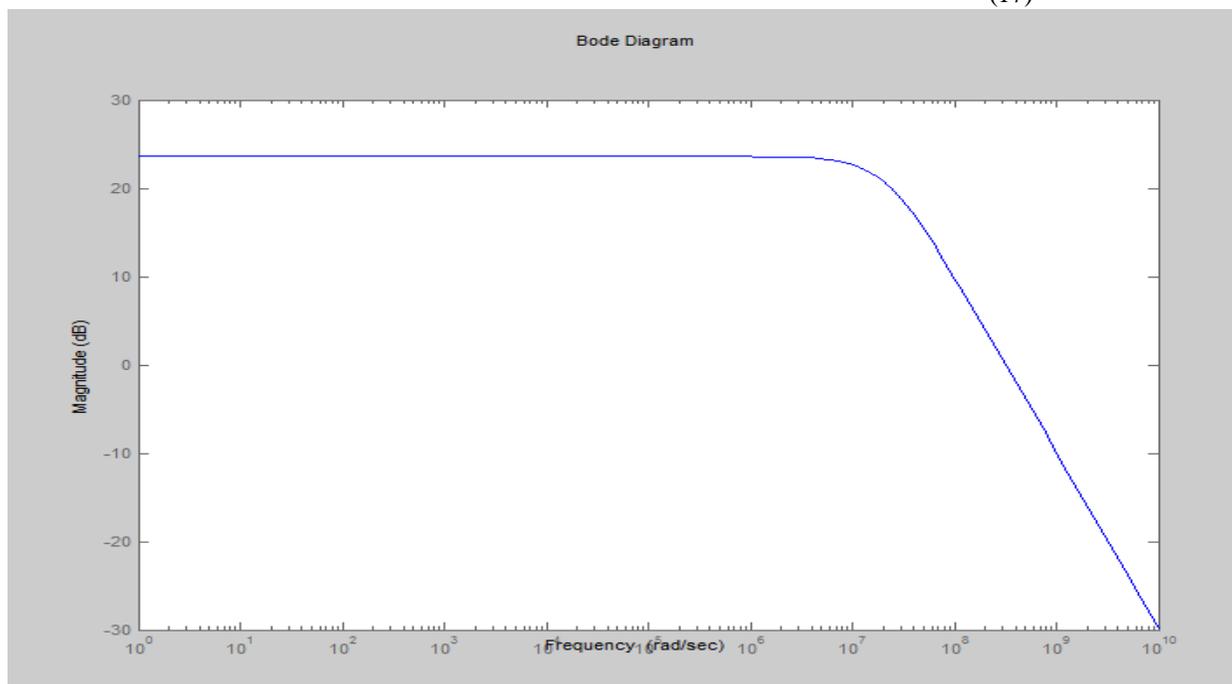


Fig. 8: Theoretical Frequency Response for Cascode Amplifier

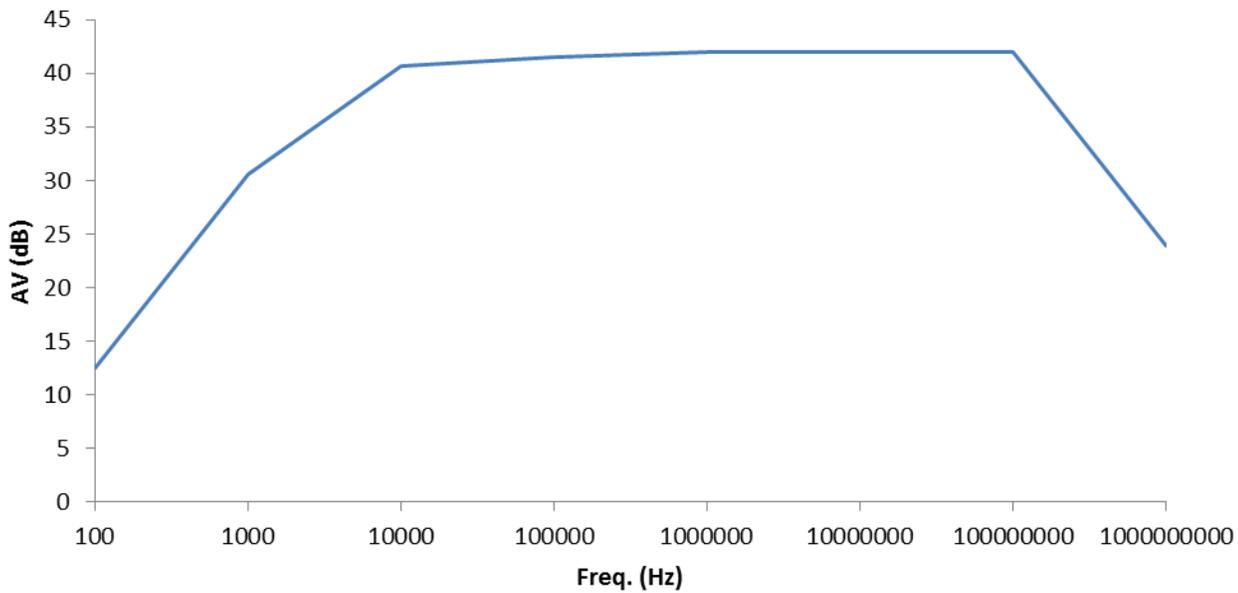


Fig. 9: Simulated Frequency Response for Cascode Amplifier

The gain of the simulated amplifier was found to be 41.94dB with a bandwidth of 478mHz

3.2 The antenna array

An antenna array is a matrix of two or more antenna connected electrically. All the individual radiators of the array are similar and the array element being the half-wave dipole. The discrete antenna detect individually but the total field received is the vectors addition of the field due to each antenna element (Yerraw, 2012). The radiation pattern of the array depends on the relative amplitude and phase of the detected signal of each antenna and the geometric spacing of the array element the four element is one in which all the radiators are in line with equal spacing between adjacent pairs as shown below:

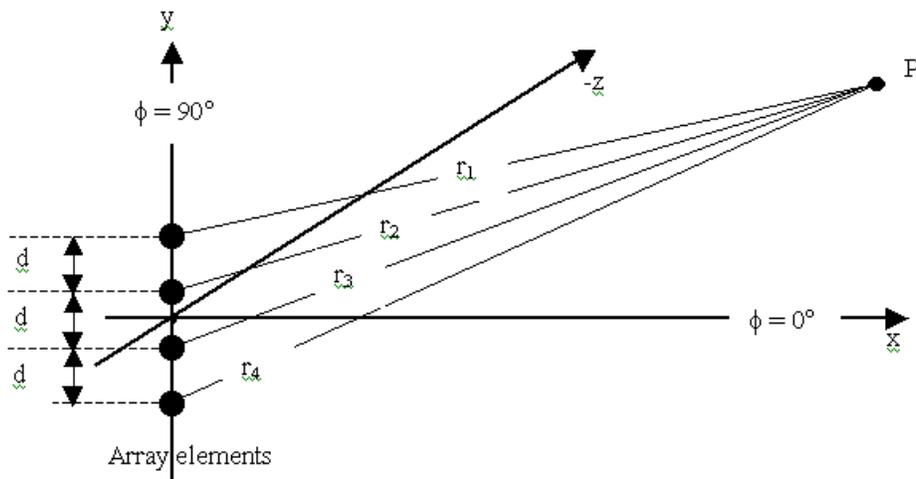


Fig. 10: 4-Element Array Geometry

One of the principal advantages of the array is that the radiation pattern can be in broadside or endfire array. If the maximum intensity is radiated in a direction along the line of the array, “off the end” rather than off the side, hence, the name endfire array as shown in Figure 11.

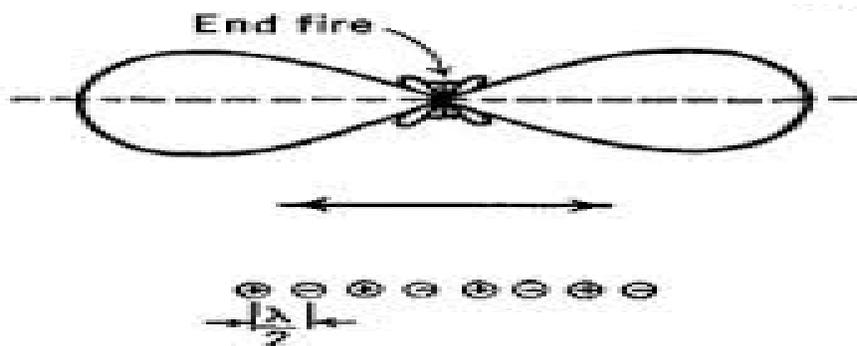


Fig. 11: Endfire Array

If the maximum intensity is in direction perpendicular to the direction of array such configuration is called a broadside array as shown in the Figure 12.

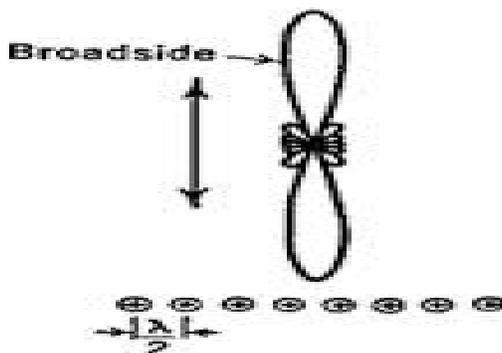


Fig. 12: Broadside Array

The method of analysis is suggested by showing a field point P joined by ray lines to each element such an array is called a linear array. The all element are radiating with equal intensity and the phase different between adjacent element is constant.

From equation (15) if the amplitudes a_1, a_2, a_3 and a_4 are the same with the same phase difference, it is shown that the intensity of the light at any point will be proportional to the squares of the resultant amplitude (Jenkins and White, 1957).

$$I \sim A^2 = a^2 + a^2 + a^2 + a^2 + 2a^2 + 2a^2 + 2a^2 + 2a^2 + 2a^2 + 2a^2 \tag{18}$$

$$= I \sim A^2 = 16a^2 \tag{19}$$

IV. DISCUSSION

We found the addition of the transmitted power in space to overcome the losses of signal strength in the distributed power amplifier configuration to be very useful. This work also eliminates the possibility of overheating the circuit board when adequate heat is developed from the insertion losses.

Adopting the proposed technique at backhaul location would further reduce cost of handling cooling systems due to heat develop in the circuits from the large currents present in the DA configuration.

V. CONCLUSION

In conclusion, it can be seen that the use of power splitter at the input stage of amplifiers and array antennas at the output section

of the active antenna eliminate power lose in the circuit and give more chances of enhancing transmitted power of signals compared to the gain-bandwidth restriction present in the amplifying devices.

REFERENCES

- [1] Abdul-Raheem, A.A. (2010). "Design and Simulation of N – Way in Phase Equal Power Wilkinson Power Divider". Eng. and Tech. Journal.Vol.28, No. 12.
- [2] Ali, M.H. and Dambatta, U.G. (2000), "Design of a Small Signal Oscillators Based on Distributed Amplifier"Sci. Forum, J. Pure and Applied Sci. 3(2) 163-169
- [3] Daniel, D.H. (2010). "Novel Design of a Wideband Ribcager Dipole Array and Its Feeding Network". Unpublished Master Thesis of Science in Electrical and Computer Engineering, Worcester Polytechnic Institute, United States of America.
- [4] Dogman, M. and Jenkins, I. (2010). "A tunable X_Band SIGE HBT Single Stage Cascode LNA". 11. IEEE Microwave symposium.

- [5] Harvey, J., Brown, E.R. and York, R.A. (2000). "High Power Transmitter", IEEE Microwave, PP.48 – 50.
- [6] Jenkins, F.A. and White, H.E. (1957). "Fundamentals of Optics". McGraw - Hill Book Company Inc. United States of America. Third edition. PP. 211 – 214.
- [7] Kraus, J.D. (1988). "Antenna". 2nd edition. McGraw-Hill Book Company, New York. PP.230-231
- [8] Kushwaha, R.S. and Srivastava, D.K. (2013). "Bandwidth Enhancement of A Microstrip Patch Antenna with Square Shape Parasitic Elements". International Journal of Advanced Research in Computer Science and Software Engineering. Vol.3(12).
- [9] Philip, F., Brian, T. and Yves, V. (2000). "Design and Simulation of a 5GHz Distributed amplifier", IEEE Transaction on solid state circuits. Vol.35, No. 2. PP. 2-4.
- [10] Rashid, M.H. (2011). "Microelectronic Circuits, Analysis and Design", 2ndEdition.Cengage Learning, Inc.PP.490-492
- [11] Sedra, A.S. and Smith, K.C. (2004). "Microelectronics Circuits". 5thedition.Oxford University Press. PP.150-153
- [12] Wolf, G., Demichel, S., Leblanc, R., Blache, F., Lefevre, R., Dambrine, G. and Happy, H. (2005). "A Metamorphic GaAs HEMT Distributed Amplifier with 50 GHz Bandwidth and Low Noise for 40 Gbits/s Optical Receivers". Institute d' Electronique de Micro e'lectroniqueet de nanotechnologie (IEMN) 13th GAAS symposium – Paris.
- [13] Yerraw, R. (2012). "Antennas for Modern Wireless, Communication". Institute of Electronic and Telecommunication Engineers (IETE). PP. 1-2

AUTHORS

First Author – M.H. Ali, Department of Physics, Bayero University Kano, Kano, Nigeria, E – Mail:alim@buk.edu.ng
Second Author – S. Muhammad, Department of Physics, Ibrahim Babangida University Lapai, Niger State, Nigeria. E – Mail: Muhammadsadiq1987@gmail.com

Intrusion Detection System

Kashish Kukreja, Yugal Karamchandani, Niraj Khandelwal, Kajal Jewani

Department of Computer Science, Vivekanand Education Society's Institute of Technology, Mumbai, INDIA

Abstract- In our project we have implemented an intrusion detection mechanism in NFS (Network File System). As NFS is a distributed file system and there is no pre-defined authentication mechanism in NFS, it inspired us to go ahead with this project. Intrusion detection can act as a layer of security as it distinguishes legitimate clients and intruders. In this project we have decided on certain parameters related to the client (for example -used id, password, number of mount requests etc.). These parameters are stored in a log file. Then these parameters are compared to parameter thresholds from the access control list file in order to detect anomalous behavior of the client. The basis for intrusion detection is a parameter named sum. Sum is the combination of all parameters. These parameters are scaled by a particular factor depending on their importance in determining the client's behavior. If the value of sum for a particular client is greater than threshold then it is identified as a normal client and it is granted access but if the value of sum is less than zero then the client is identified as an intruder and it is sent to decoy.

Index Terms- Client, Server, NFS

I. INTRODUCTION

As computer networking grows more important in daily usage, its security is also paramount. Intrusion Detection System (IDS) is an important and integrated component of computer network infrastructure. As a network security watchdog, IDS is often deployed at the border of enterprise network. Because of ever-increasing volume of clients and network complexity, there is a need of better IDS that can deliver result in real-time. As we are working with NFS (Network File System) and there is no provision for authentication in NFS, it motivated us to design a mechanism similar to intrusion detection system in order to provide a layer of security to NFS. There is an NFS server that has data files and it allows client to mount and get access to the data. There are multiple clients that can request mount to the server. In order to get a mount response the client must authenticate itself with a valid user id and password pair. The details regarding the clients' activities are stored in a log file. Different thresholds are defined for different client parameters and these thresholds are compared to the actual values of the client parameters in order to distinguish between normal clients and intruders.

II. LITERATURE SURVEY

Intrusion detection systems (IDS) monitor packets on the network wire and attempt to discover if a hacker/cracker is

attempting to break into a system (or cause a denial of service attack). A typical example is a system that watches for large number of TCP connection requests (SYN) to many different ports on a target machine, thus discovering if someone is attempting a TCP port scan. An IDS may run either on the target machine who watches its own traffic (usually integrated with the stack and services themselves), or on an independent machine promiscuously watching all network traffic (hub, router, probe). Note that a "network" IDS monitors many machines, whereas the others monitor only a single machine (the one they are installed on). Intrusion Detection systems can be classified into three categories based on the types of data they examine. These are:

Host Based IDS

Network Based IDS

Application Based IDS

In the host based approach every host has its own IDS and it collects data in the low level operations like network system calls (Monitoring connection attempts to a port, etc.). A network based IDS collects data in the network level, transparently to the other hosts. Their sensors are located somewhere in the network and monitor network traffic. And the third type of IDS, the application based approach uses data sources from running applications as its input.

Network File System (NFS) is a distributed file system protocol originally developed by Sun Microsystems in 1984, allowing a user on a client computer to access files over a network much like local storage is accessed. NFS, like many other protocols, builds on the Open Network Computing Remote Procedure Call (ONC RPC) system. The Network File System is an open defined in RFCs, allowing anyone to implement the protocol. NFS is often used with UNIX operating systems (such as Solaris, AIX and HP-UX) and Unix-like operating systems (such as Linux and FreeBSD). It is also available to operating systems such as the classic Mac OS, OpenVMS, Microsoft Windows, Novell NetWare, and IBM AS/400.

III. ALGORITHM

1. Server and Clients Starts
2. The client who wants to access data on the server will send a mount request to the server
3. For sending the mount request the client has to authenticate itself to the server.
4. If the user id and password are correct then the mount request is made.
5. When the mount request is made the client's attributes are stored in a log file.

6. These attributes are then compared with the thresholds specified in the ACL file.
7. The SUM attribute is calculated depending on the parameters like no. of dos attempts, no. of wrong passwords etc.
8. If the value of SUM is greater than a particular threshold then the client is identified as a normal client and mount request is served. The client can then access the shared data.
9. If the value of SUM is less than the threshold then the client is identified as a potential intruder and sent to decoy.
10. If a mounted client sends an unmount request then it is unmounted and it can no longer access the data.

IV. SYSTEM BLOCK DIAGRAM

Systems are created to solve problems. One can think of the systems approach as an organized way of dealing with a problem. In this dynamic world, the subject System Analysis and Design, mainly deals with the software development activities

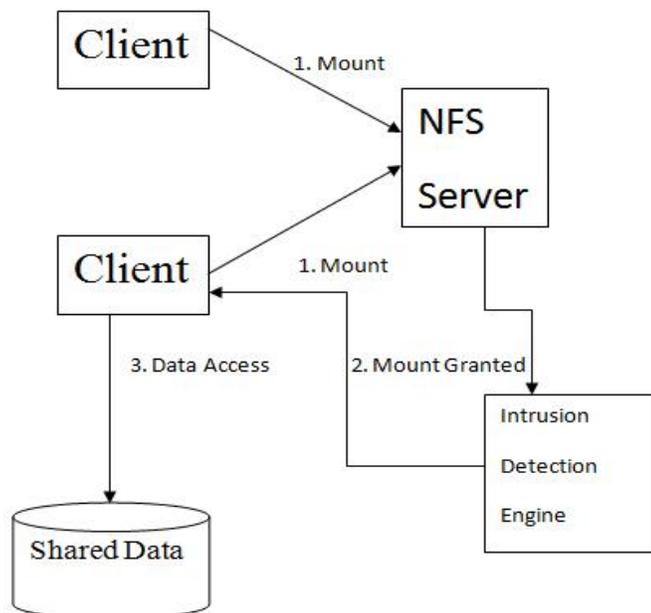


Fig 3.5 System block diagram

V. RESULT ANALYSIS

The Crucial parameter for intrusion detection is the sum parameter which is a combination of various other parameters. Sum is calculated as follows

$$\text{Sum} = 5 * (\text{No. of Dos attempts}) + 4 * (\text{Current time} - 1^{\text{st}} \text{ start time} / \text{no. of mount}) + 3 * (\text{No. of times wrong password entered}) + 2 * (\text{No. of accesses in unallowed time period}) + 1 * (\text{Total elapsed time} / \text{No. of times successfully mounted.})$$

The scaling factors 5, 4, 3, 2, 1 are demo values and these values can change at run time. These values are priorities of particular and they are different for different clients.

The other parameters are the fields of the 3 log files and some of them are as follows:

- IP address
- User id
- Password
- No. of DOS attempts
- No. of times wrong password entered
- Start time
- End time
- Total Elapsed time etc.

VI. CONCLUSION

Thus we have designed an authentication and intrusion detection mechanism for network file system. As NFS works in a distributed environment, this mechanism can prove useful as it will protect crucial data from illegitimate users. As there is no predefined security mechanism in NFS, this mechanism can be employed as a first level of security.

ACKNOWLEDGMENT

We are thankful to our college Vivekanand Education Society's Institute of Technology for considering our project and extending help at all stages needed during our work of collecting information regarding the project.

It gives us immense pleasure to express our deep and sincere gratitude to Assistant Professor **Prof. Kajal Jewani** (Project Guide) for her kind help and valuable advice during the development of project synopsis and for her guidance and suggestions. We are deeply indebted to Head of the Computer Department **Dr.(Mrs.)Nupur Giri Ma'am** and our Principal **Dr. (Mrs.) J.M.**

Nair Ma'am, for giving us this valuable opportunity to do this project.

We express our hearty thanks to them for their assistance without which it would have been difficult in finishing this project synopsis and project review successfully.

We convey our deep sense of gratitude to all teaching and non-teaching staff for their constant encouragement, support and selfless help throughout the project work. It is great pleasure to acknowledge the help and suggestion, which we received from the Department of Computer Engineering. We wish to express our profound thanks to all those who helped us in gathering information about the project. Our families too have provided moral support and encouragement at several times.

REFERENCES

- [1] Marks, Crosby, former Haystack Project team member and Haystack Labs employee, telephone interview, September 3, 2001.
- [2] McHugh, J. et al. "Intrusion Detection: Implementation and Operational Issues," Software Engineering Institute Computer Emergency Response Team White Paper, January 2001.
- [3] Power, Richard, "1999 CSI/FBI Computer Crime and Security Survey," Computer Security Journal, Volume XV, Number 2, 1999, pp. 32.
- [4] Proctor, Paul, the Practical Intrusion Detection Handbook, Prentice Hall, 2001.
- [5] Sans Institute, "Intrusion Detection and Vulnerability Testing Tools: What Works" Feb 2001.
- [6] [http://en.wikipedia.org/wiki/Network_intrusion_detection_sys tem](http://en.wikipedia.org/wiki/Network_intrusion_detection_system)

- [7] http://www.linuxsecurity.com/resource_files/intrusion_detection/network-intrusiondetection.html
- [8] <http://www.windowsecurity.com/articles/IDS-Part2-classification-methods-techniques.html#>
- [9] <http://www.securityfocus.com/infocus/1203>
- [10] http://www.bruggerink.com/~zow/papers/brugger_dmnid.pdf

Second Author – Yugal Karamchandani, pursuing B.E, Vivekanand Education Society's Institute of Technology, yugalkaramchandani@gmail.com.

Third Author – Niraj Khandelwal, pursuing B.E, Vivekanand Education Society's Institute of Technology, nirajkhandelwal.nk@gmail.com.

Fourth Author – Kajal Jewani, M.E, Vidyalankar Institute of Technology, kajal.jewani@ves.ac.in

AUTHORS

First Author – Kashish Kukreja, pursuing B.E, Vivekanand Education Society's Institute of Technology, kashish.kukreja696@gmail.com.

Effects of Problem-Based Learning in Teaching and Learning of Technical and Vocational Education and Training.

Sada, A. M, Mohd, Z. A., and Adnan, A. and Audu, R

Faculty of Education, Universiti Teknologi Malaysia, 81310, Johor Bahru, Malaysia.

Abstract- Problem-based learning (PBL) has been accepted for instruction in many fields of study since it was first introduced in medical field during the 1960's. However, this innovative teaching and learning approach is yet to be recognized in technical vocational education and training (TVET) teaching and learning in some countries. This paper discusses briefly the concept, effectiveness of PBL approach in teaching and learning in TVET. Based on the literature review, the paper concludes that, PBL is an essential tool for instructing learners in technical and vocational trades.

Index Terms- PBL, teaching and learning, TVET.

I. INTRODUCTION

The effectiveness of all education system depends largely on the quality of teaching and learning in the classroom, workshops, laboratories and other places where education takes place [1]. For effective teaching and learning to take place, skilful teachers need to use variety methods and techniques at their disposal. There is a wide diversity in teaching methods and techniques, no one method can be regarded as the best for every teaching situation [2, 3]. The decision to apply one method or another depends on a number of factors, including the teacher, the learner and the environment. It is the responsibility of the teacher to assess the situation and decide on which method or methods to use in order to accomplish the instructional objectives. The success or failure of teaching and learning depends on the inventiveness, approach and method employed by the teacher. This could also depend on an intelligent analysis of the educational purpose, the learners in the class, the curriculum content and the type of subject matter being taught.

Research conducted by [Okoye [4] Ogwu [5], Ogwo and Oranu [6] reported that no single teaching method can be said to be the most appropriate in teaching technical and vocational subjects. Petrina [7] also has the opinion that, goals cannot be achieved by a single teaching method, nor can anyone teaching method accommodate all learning styles at once; for example, demonstrations or projects are suitable for meeting some goals but not effective for meeting others. However, in TVET, most instruction is work-oriented [8]. For this to be achieved, learners must be exposed to active teaching approaches such as PBL. The participation of learners in instruction in any technical and vocational trades must be active and direct. Direct participation exists where the learner is physically involved in the academic and practical activities in that trade. The learner must be

particularly affected and exhibit positive perceptions and behaviours that indicate the attainment of the desired goals. Accordingly, the PBL approach influence the effectiveness of teaching and the ease of learning in TVET [4].

II. THE CONCEPT AND OVERVIEW OF PBL

PBL has been defined by different authors. According to Savery [9] PBL is defined as an instructional (and curricular) learner-centred approach that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem. PBL is an approach to instruction that prepares learners for real-world experience and causes them to learn how to research [10]. Mergendoller, Maxwell [11] explained that, PBL provide a more challenging, motivating and enjoyable approach to education. Furthermore, PBL is a subset of the problem-centred learning approach which is easily identifiable by the use of typically ill-structured problems which lead to ownership of the learning environment [12]. Bansal and Kumar [13] referred to the PBL package as an innovative, interesting and corroborated classroom transaction activity.

PBL has certain definite features as outlined by [10], Boud and Feletti [14]. It is a learner-centred learning process; learners collaboratively construct their own learning goals and knowledge base

- i. It is a small-group process
- ii. It is led by a facilitator rather than a teacher
- iii. Problems are set as a starting-point for learning and used as a tool for learners to build upon shared prior knowledge

III. PBL IN TVET TEACHING AND LEARNING

Increasingly, learners who are being taught using traditional methods appear to be disconnected from their studies [15]. The characteristics of the millennium generation include 'digital literacy, experiential and engaging learning, interactivity and collaboration, immediacy and connectivity' [16]. Education can no longer be exclusively based on the teacher "disseminating information/knowledge through lectures and PowerPoint slides" [17]. Shift away from the teacher-centred learning paradigm means moving to a more learner-centred constructivist paradigm of education. The learner now needs to focus on understanding, constructing knowledge, discovering and active engagement

whereby they view the teacher or lecturer as a mentor or guide [11].

Learning is not done in isolation; learners learn by doing [18]. They prefer to work in groups and they embrace collaborative learning [18]. They actively participate in the learning process, but more importantly, they are looking for direction, mentoring, guidance, feedback and good communication channels [19]. PBL incorporates this approach by offering a holistic approach to teaching and learning and may well provide for greater flexibility in teaching design. The focus of educators should be on engagement and discussion, allowing learners to contemplate the material put forward, as well as to comment and question. PBL allows educators to do just that. Industry is telling the education sector they need graduates who are job ready, who are able to be productive immediately and who have a good understanding of the business they are about to be employed in. Industry also wants graduates who can be productive in the workplace from day one, so there is a clear need for PBL in the TVET sector to ensure that the needs of industry are fulfilled [20].

The need for PBL in TVET teaching and learning stem from the fact that teaching and learning in TVET has to do with world of work and the practical application of learning and skills. The emphasis in approach has also shifted away from teaching content and more towards facilitating learning and empowering learners. Particularly, in this new knowledge era, the workplace contains more complicated and sophisticated high-tech equipment and computerized systems, which create more complex and ill-structured problems (Tan et al., 2009; Zhou, 2012a).

IV. EFFECTIVENESS OF PBL IN TECHING AND LEARNING IN TVET

The PBL approach has proven to be effective in the teaching and learning of technical and vocational trades. PBL has been claimed to encourage deep learning in learners [21]; [22] & [23]. PBL leads to the increased use of meaningful “deep” approaches by learners in relating to the material and the decreased use of reproductive “shallow” approaches. PBL also offers opportunities for learners to learn in teams, develop presentation skills, learn negotiation abilities and develop research skills and many other abilities [21]. Furthermore, in an environment of an increased number of learners decreased resources and overextended teachers, PBL is seen as an alternative approach to teaching a larger number of learners using less face- to- face contact [21]. [Robbs and Meredith \[24\]](#) list a number of advantages that are associated with PBL modes of learning as an alternative to traditional methods:

- An increased retention of information;
- The development of an integrated (rather than discipline-bound) knowledge base;
- An encouragement towards lifelong learning;
- A greater exposure to expert experience and at an earlier stage in the curriculum;
- An increased learner-teacher liaison; and
- An increase in overall motivation.

According to [Force \[25\]](#) and [Gravells \[26\]](#), PBL is the most effective active learning method known to make a positive impact on the learners’ experience. PBL is particularly effective in supporting learning, helping learners to move from surface learning to deep and profound understanding. This approach is generic and be applicable to all technical and vocational trades programmes. Furthermore, [27]; [28] posit that integration of PBL in TVET will definitely reduce the gap between theory and practice, simply because PBL provides engaging and challenging learning materials and flexible space for learning through activity. It is therefore that we should work hard to help students make the connections between the micro and the macro, between the everyday details of their lives and the broader world in those details that finally do make a difference.

V. CONCLUSION

Using the PBL approach in teaching and learning in TVET will accelerate the learners’ high level skills in communication and information retrieval which will enable individuals to gain and apply new knowledge and skills as needed. Adapting PBL as teaching approach, will help learners to develop the ability to arrive at informed judgments by effectively defining problems, gathering and evaluating information related to those problems, and developing solutions; the ability to function in a global community; adaptability; ease with diversity; motivation and persistence (for example being a self-starter); ethical and civil behaviour; creativity and resourcefulness; technical competence; and the ability to work with others, especially in team settings. Lastly, learners will demonstrate the ability to deploy all of the previous skills to address specific problems in complex, real-world settings, in which the development of workable solutions is required. Given this set of opportunities from using the PBL approach in teaching and learning in TVET and the apparent success of the PBL approach at producing graduates with these characteristics, it is hoped that the use of PBL in TVET teaching and learning will continue to receive support.

REFERENCES

- [1] Lucas, B., E. Spencer, and G. Claxton, How to teach vocational education. 2012.
- [2] Okorie, J.U., Fundamental of Teaching Practice. Book, 1979: p. 152-163.
- [3] Baba, N.M., Basic Principles and Methods of Teaching. 2007, Joyce Publishers: Kaduna, Nigeria.
- [4] Okoye, K., Enhancing Quality in Educational Practice and Instructional Delivery by Teachers of Technology and Vocational Education in Nigeria. African Research Review, 2010. 4(2).
- [5] Ogwu, M., The Roles of Teachers in National Development M. D OGWU. Kubanni Journal of Arts and Social Sciences, 2007(2): p. 14.
- [6] Ogwo, B. and R. Oranu, Methodology in Formal and Non-formal Technical/Vocational Education. Uwani Enugu: Ijejas printer and publishers company, 2006.
- [7] Petrina, S., Curriculum and instruction for technology teachers. Online: <http://www.cust.educ.ubc.ca/programs/tsed/research/books>, 2004.
- [8] Nwachukwu, C.E., Designing Appropriate Methodology in Vocational and Technical Education for Nigeria. 2006: p. 141-142.
- [9] Savery, J.R., Overview of problem-based learning: Definitions and distinctions. Interdisciplinary Journal of Problem-based Learning, 2006. 1(1): p. 3.

- [10] Myers, S.C. Problem Based Learning in an Applied Econometric Curriculum. in Poster Session, Teaching Ideas and Projects, Allied Social Science Association Meetings, New Orleans. 2008.
- [11] Mergendoller, J.R., N.L. Maxwell, and Y. Bellisimo, The effectiveness of problem-based instruction: A comparative study of instructional methods and student characteristics. *Interdisciplinary Journal of Problem-based Learning*, 2006. 1(2): p. 5.
- [12] Greening, T., Scaffolding for success in problem-based learning. *Medical Education Online*, 1998. 3.
- [13] Bansal, V. and R. Kumar, Activity Based Learning NewMethod of Learning:-A Case Study of TEACH-NEXT. 2010.
- [14] Boud, D. and G. Feletti, Changing problem-based learning: Introduction to the second edition. The challenge of problem-based learning, 1997: p. 1-14.
- [15] Eubanks, S., Millennials–Themes in Current Literature. Retrieved July, 2006. 23: p. 2010.
- [16] Barnes, K., R. Marateo, and S.P. Ferris, Teaching and learning with the net generation. 2007, Innovate.
- [17] Sherer, P. and T. Shea, Using online video to support student learning and engagement. *College Teaching*, 2011. 59(2): p. 56-59.
- [18] Skiba, D.J. and A.J. Barton, Adapting your teaching to accommodate the net generation of learners. *Online Journal of Issues in Nursing*, 2006. 11(2): p. 15.
- [19] McCrindle, M., New generations at work: Attracting, recruiting, retaining and training Generation Y. 2006: The ABC of XYZ.
- [20] Mossuto, M., Problem-Based Learning: Student Engagement, Learning and Contextualized Problem-Solving. Occasional Paper. National Centre for Vocational Education Research (NCVER), 2009.
- [21] Cowan, J., Maggi Savin-Baden 2000. Problem-Based Learning in Higher Education: Untold Stories. *Higher Education*, 2001. 42(1): p. 139-140.
- [22] Coles, C.R., Differences between conventional and problem-based curricula in their students' approaches to studying. *Medical education*, 1985. 19(4): p. 308-309.
- [23] Newble, D. and R. Clarke, The approaches to learning of students in a traditional and in an innovative problem-based medical school. *Medical education*, 1986. 20(4): p. 267-273.
- [24] Robbs, J. and S. Meredith, The problem-based learning curriculum at Southern Illinois University School of Medicine [online] 1994. 1994.
- [25] Force, C.P.T., Towards a strong careers profession. Department for Education, London, 2010.
- [26] Gravells, A., Delivering employability skills in the lifelong learning sector. 2010: SAGE.
- [27] Woltering, V., et al., Blended learning positively affects students' satisfaction and the role of the tutor in the problem-based learning process: results of a mixed-method evaluation. *Advances in Health Sciences Education*, 2009. 14(5): p. 725-738.
- [28] Ahlfeldt*, S., S. Mehta, and T. Sellnow, Measurement and analysis of student engagement in university classes where varying levels of PBL methods of instruction are in use. *Higher Education Research & Development*, 2005. 24(1): p. 5-20.

AUTHORS

First Author- Sada, Adamu Maigari, B.Ed. (Tech), (ABU), Zaria, Nigeria, M.Ed. (Tech), (UTM); PhD Student Universiti Teknologi, Malaysia (UTM), 81310, Johor Bahru, Malaysia., Email- sadamaigari67@yahoo.com or amsada2@gmail.com, +60166120954.

Second Author- Mohammad Zolkifli Bin Abdul Hamid, B.Sc. (Hons), Dip. Ed (PG0, M. Ed., PhD., Universiti Teknologi, 81310, Johor, Bahru, Malaysia, mohdzol@utm.my, +60137783990.

Third Author- Adnan Bin Ahmad, B.Ed., M.Ed., PhD. nanjb19@yahoo.com, +60189680804, Universiti Teknologi, 81310, Johor Bahru, Malaysia.

Fourth Author- Audu Rufa'i, B. Ed., M. Ed., (FUT), Minna, Nigeria, PhD (UTM), audu.rufai@yahoo.com, +2348033174958.

Correspondence Author- Sada, Adamu Maigari, B.Ed. (Tech), (ABU), Zaria, Nigeria, M.Ed. (Tech), (UTM); PhD Student Universiti Teknologi, Malaysia (UTM), 81310, Johor Bahru, Malaysia., Email- sadamaigari67@yahoo.com or amsada2@gmail.com, +60166120954.

Azimuthal Resistivity Sounding with the Symmetric Schlumberger and the Alpha Wenner Arrays to study subsurface electrical anisotropy variation with depth

Van-Dycke Sarpong Asare*, Emmanuel Gyasi*, Bismark Fofie Okyere*

* Department of Physics, Kwame Nkrumah University of Science and Technology, Kumasi

Abstract- Azimuthal apparent-resistivity measurements have been conducted using two very common resistivity electrode configurations for the purpose of determining the extent to which each of the electrode arrays could elicit anisotropy information from the subsurface. Apparent resistivity sounding were conducted along four different azimuths about a common center to provide resistivity variation with azimuth. The apparent resistivities are plotted as function of azimuth in radial coordinates to produce polygons of anisotropy for each depth of investigation. On the polar diagrams, anisotropy manifests as variation from near circular to elliptic shapes with ellipses with high eccentricity depicting high anisotropy. With this metaphor, the strike of the anisotropy causative subsurface feature is represented by the major axis of the ellipse. The coefficient of anisotropy was found within the range of 1.030 to 1.308 and 1.125 to 1.588 respectively for the Wenner and Schlumberger arrays indicating the Schlumberger array was more receptive to anisotropy conditions. The predominant electrical anisotropy direction is the NW – SE. Anisotropic variation with depth was also investigated for both electrodes arrays and a linear model was obtained. Statistical analysis at a 0.05 confidence interval was performed on the gradients to determine whether they were significant. Coefficient of anisotropy variation with depth was found to be insignificant for both configurations, more especially the Wenner. Thus for both arrays, expanding the electrode spacing did not significantly reveal any significant change in the anisotropy.

Index Terms- Fractures, orientation, subsurface, anisotropy, Azimuthal Sounding

I. INTRODUCTION

Rotational resistivity sounding surveys are occasionally embarked upon to measure subsurface electrical anisotropy. In the geophysical lexicon, a rock is said to be electrically anisotropic if the value of a vector measurement of its resistivity varies with direction (Taylor and Flemming, 1988), (Sheriff, 2013). Subsurface anisotropy contains prints of subsurface fracturing, layering, faults and joint systems, grain boundary cracking among others. Besides, the presence of lateral heterogeneities can produce significant pseudo-anisotropy effect. Anisotropy is therefore jointly influenced by these factors. Fractures are important in engineering, geotechnical, hydrogeological and environmental practice because they provide pathways for fluid flow. Many economically significant petroleum, geothermal, and water supply reservoirs form in fractured rocks. Fracture systems control the dispersion of chemical contaminants into and through the subsurface. They also affect the stability of engineered structures and excavations (NAP, 1996). Fracture and fracture networks are mapped by determining their orientation, density, aperture and sometimes the fracture-filling material under the in-situ temperature and pressure conditions.

Considering the causes of electrical anisotropy such as those outlined above, the concept has very important implications in geo-electrical resistivity survey, data inversion and interpretation. If the subsurface under investigation is anisotropic and the anisotropy is ignored, convenient assumptions fail and actual geological depths and geologic structures are wrongly imaged and interpreted. It has also been shown that the inversion of geoelectrical sounding data from an anisotropic underground structure with an isotropic model can strongly distort the image of the resistivity distribution of the Earth (Changchun, 2000), (Matias 2002, Mathias and Habberjam, 1986) are few examples of papers which have dealt with the subject of the effects of anisotropy on surface resistivity measurements.

In this present paper effort is made to broadly investigate fracture anisotropy using two of the most common electrode arrays; the alpha Wenner and the symmetric Schlumberger arrays. Specifically the paper tries to establish the effectiveness of the alpha Wenner and symmetric Schlumberger resistivity sounding in the determination of electrical resistivity anisotropy. It also aimed at quantitatively determining the anisotropy coefficient from both spreads and also to compare their results.

Azimuthal resistivity and its measurement

When conducting electrical resistivity surveys with a collinear set of electrodes as described above, most of the current paths sample the subsurface below the survey line. We can take advantage of this specific subsurface sampling by varying the azimuth of resistivity surveys in an effort to measure directional variations of electrical properties. This technique can be sensitive to variations in a subsurface that has preferentially aligned fractures. Line azimuths that are perpendicular to water-filled fractures for example should exhibit higher resistivities, affording mapping of the direction of subsurface fracturing. Again, according to Boadi et al, the presence of aligned vertical features and vertical to subvertical thin beds cause anisotropic behavior in rocks and observed changes in apparent resistivity with azimuth are typically interpreted to indicate fracture anisotropy.

The sensitivity of apparent resistivity to anisotropy parameters for the traditional and special type of arrays have been studied in (Semenov, 1975, Bolshakov et al., 1997, 1998b). Watson and Barker (2005) showed how, in the same way, lateral changes in resistivity, which also produce pseudo-anisotropy effects in conventional surveys, can be identified using the offset Wenner technique.

There are other methods of anisotropy parameters determination. Some of these are based on measuring the second derivatives of the electric potential from a point current source (Mousatov, et. al., 2000). This technology consists in the tensor measurements of the electric field using specially distributed groups of transmitting and receiving electrodes (tensor array).

Theoretical considerations

The simplest form of anisotropy is the one for which the resistivity is measured respectively along and perpendicular to the bedding plane. Rocks, predominantly shale, schist, limestones and slates, have definite anisotropic character with respect to these bedding planes (Telford et al, 1990). Resistivity is assumed to be uniform in the horizontal direction with a value ρ_h , and in the vertical direction has a constant value of ρ_v . Recognizing the electrical anisotropy, the equipotential surface due a point current source is an ellipsoid symmetrical about the z axis;

$$V = -\frac{I\rho_h\lambda}{2\pi}(x^2 + y^2 + z^2)^{\frac{1}{2}} \quad 1$$

Where the coefficient of anisotropy $\lambda = \left(\frac{\rho_v}{\rho_h}\right)^{\frac{1}{2}}$, (Telford et al, 1990). Considering a point a distance r_1 from a current source, the potential at that point will be

$$V = -\frac{I\rho_h\lambda}{2\pi r_1} \quad 2$$

Introducing $\lambda = \left(\frac{\rho_v}{\rho_h}\right)^{\frac{1}{2}}$ into this equation, we have

$$V = -\frac{I(\rho_v\rho_h)^{\frac{1}{2}}}{2\pi r_1} \quad 3$$

The latter equation explains that the potential is equivalent to that of an isotropic medium but of equivalent resistivity $(\rho_v\rho_h)^{\frac{1}{2}}$.

In practice, the apparent resistivities are plotted as function of azimuth in radial coordinates to produce polygons of anisotropy for each depth of investigation.

Two characteristics of this polygon namely its orientation and the anisotropy parameter, are the elements which respectively describe and quantify the anisotropy. The first is the orientation of the best-fitting ellipse, which is given by the strike azimuth of the major axis of the ellipse. The second consists of parameters to quantify the anisotropy (Busby, 2000). The length of the major axis of the ellipse is numerically equivalent to the transverse resistance $\rho_t \equiv \rho_{MAX}$ while the length of the minor axis is numerically equivalent to the longitudinal resistivity $\rho_l \equiv \rho_{MIN}$. The coefficient of anisotropy, λ is the root of the ratio ρ_t / ρ_l (Habberjam 1975).

$$\lambda = \sqrt{\frac{\rho_{MAX}}{\rho_{MIN}}} \quad 4$$

The major axis of the ellipse, which can fit any of such anisotropic polygons, gives the strike direction of the fracture.

II. METHOD

The azimuthal resistivity measurements were conducted with the Terrameter SAS 4000 C by ABEM. Both Schlumberger and Wenner soundings were conducted along four azimuthal profiles (Fig. 1) to define the variation of apparent resistivity with orientation. The radial vertical electrical sounding involves surface measurements of VES data along four different azimuths, namely 0° – 180°, 045° – 225°, 090° – 270° and 135° – 315° for both array configurations. These respectively correspond to N-S, NE-SW, E-W and NW-SE geographical azimuths. For each Schlumberger profile, the current electrode spacing ($2L$) was expanded from 6.0 m in steps of 4 m till the whole profile is covered. The distance between the potential electrodes was fixed at 2.0 m. For the Wenner sounding, the inter-electrode separation, a , was expanded from 2 m in steps of 2 m to cover the whole length of the profile.

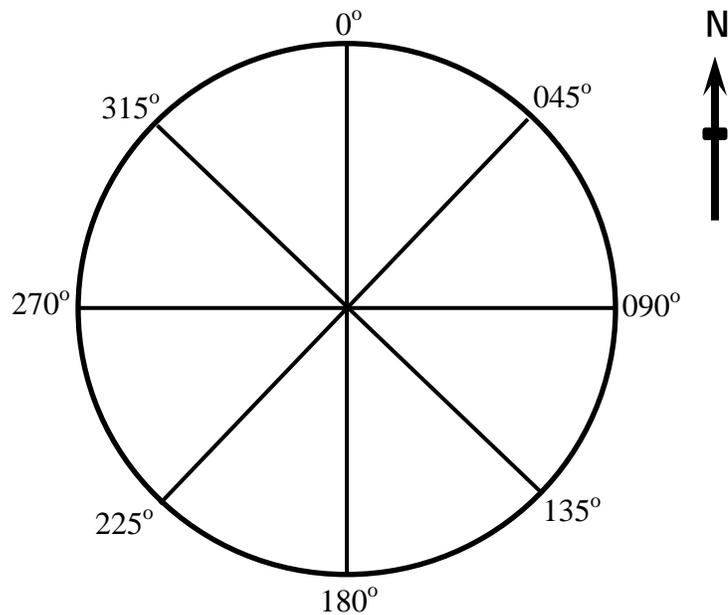


Fig. 1 Orientation of Azimuthal profiles

III. RESULTS AND DISCUSSIONS

Presentation of Results

In this study, the data and results are organized and presented in three graphical forms: Log-log Resistivity soundings curves, Polygons of anisotropy and anisotropy-depth scatter plots.

Apparent Resistivity Sounding Curves

From the field results apparent resistivity values were calculated along each profile and plotted against current electrode spacing a (or $AB/2$), on log-log graphs. The sounding curves for the Wenner array in various azimuths are presented on one graph (Fig. 2) and those for the Schlumberger array are also presented on a separate graph (Fig. 3).

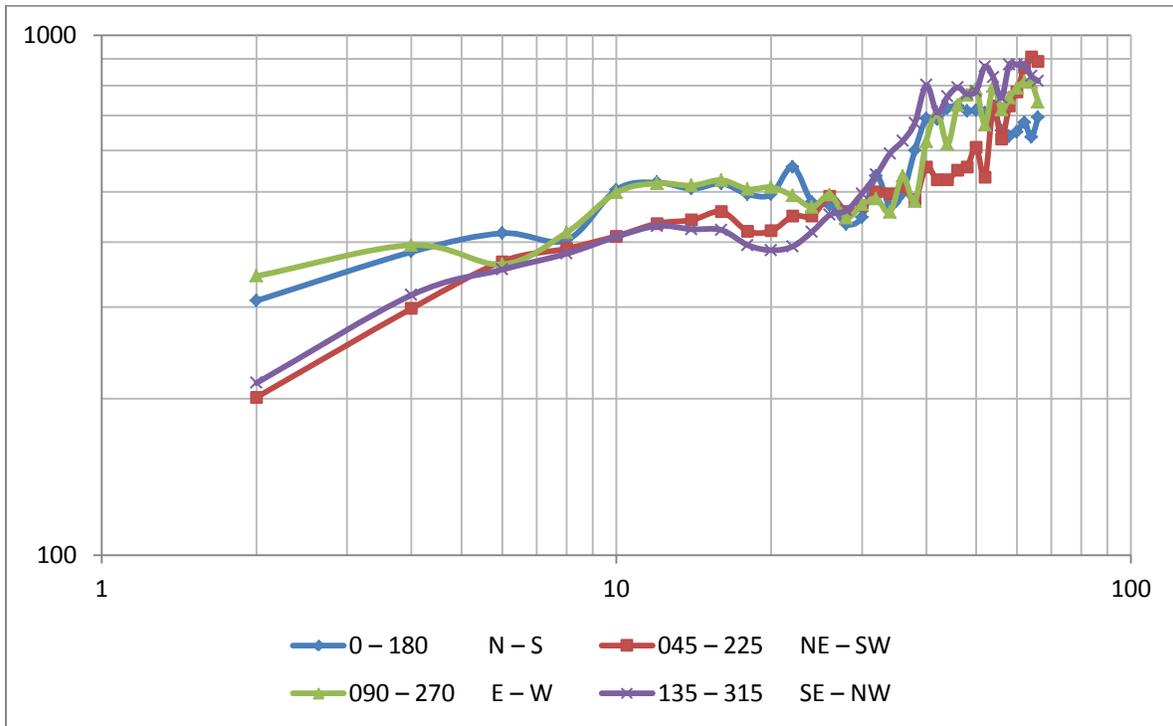


Fig. 2 Wenner Resistivity Soundings in four azimuthal directions

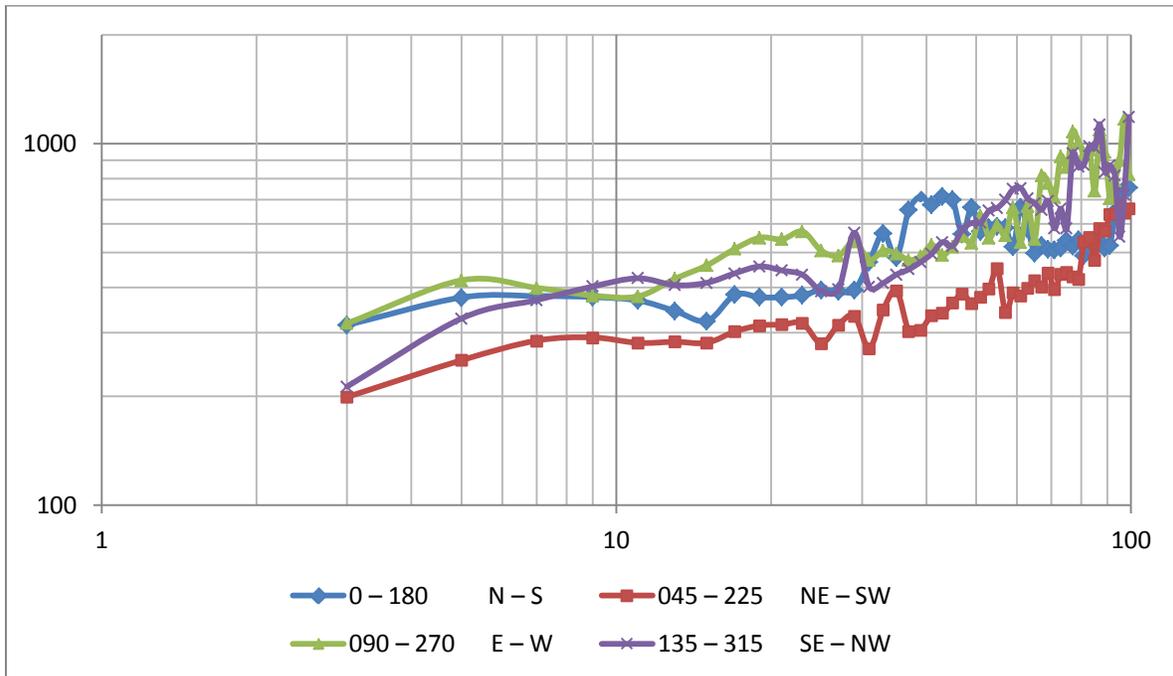


Fig. 3 Schlumberger Resistivity Soundings in four azimuthal directions

Azimuthal polar plots (Polygons of Anisotropy)

The apparent resistivities are plotted as function of azimuth in radial coordinates to produce polygons of anisotropy for each depth of investigation. A set of such polygons obtained corresponding to different AB/2 or (a) separations is known as a polar diagram or

anisotropy polygon. The square root of the ratio of the lengths of the major and minor axes of the best-fit ellipse is taken as a measure of anisotropy (Fig. 3), (Mota *et al.*, 2004). The coefficient is determined by using equation (4)

$$\lambda = \sqrt{\frac{\rho_{MAX}}{\rho_{MIN}}}$$

Where ρ_{max} is the apparent resistivity measured along the ellipse major axis; ρ_{min} apparent resistivity measured along the ellipse minor axis.

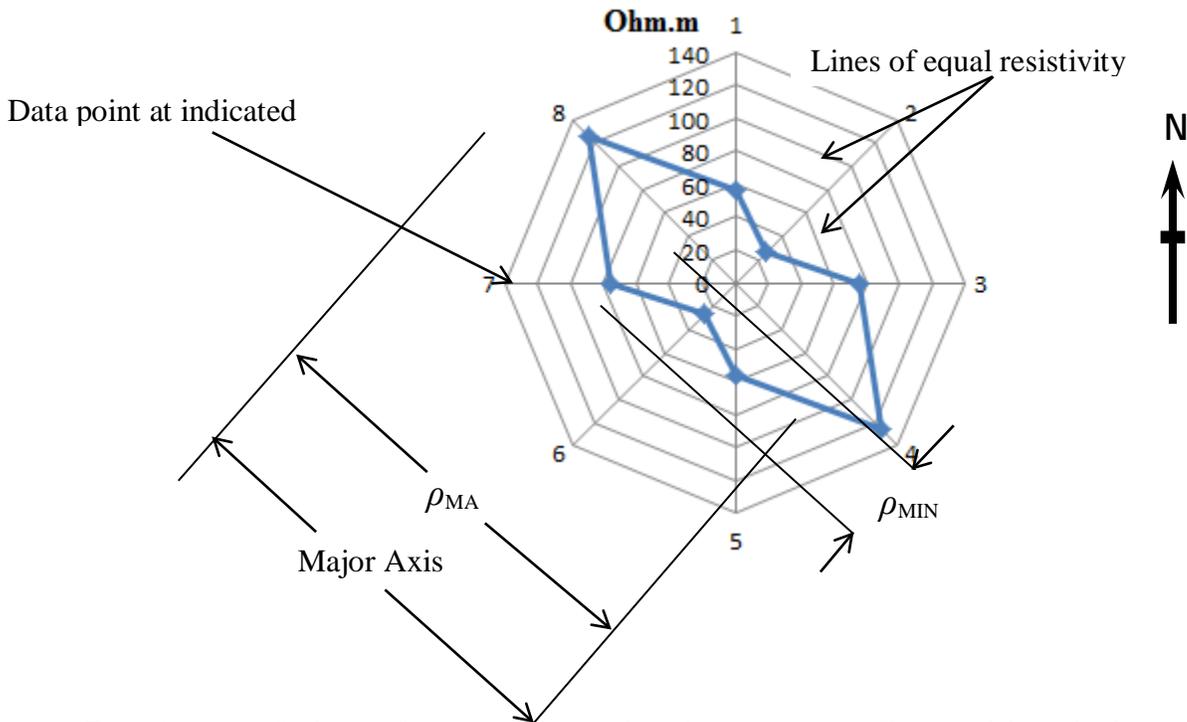
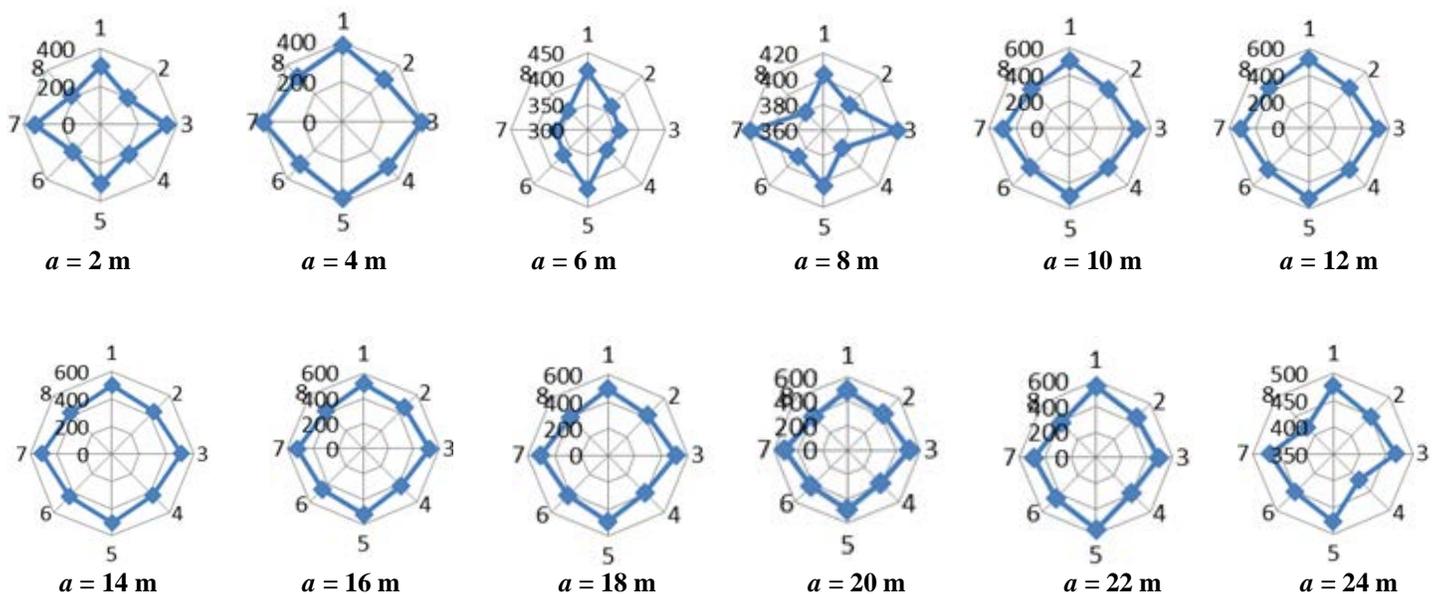
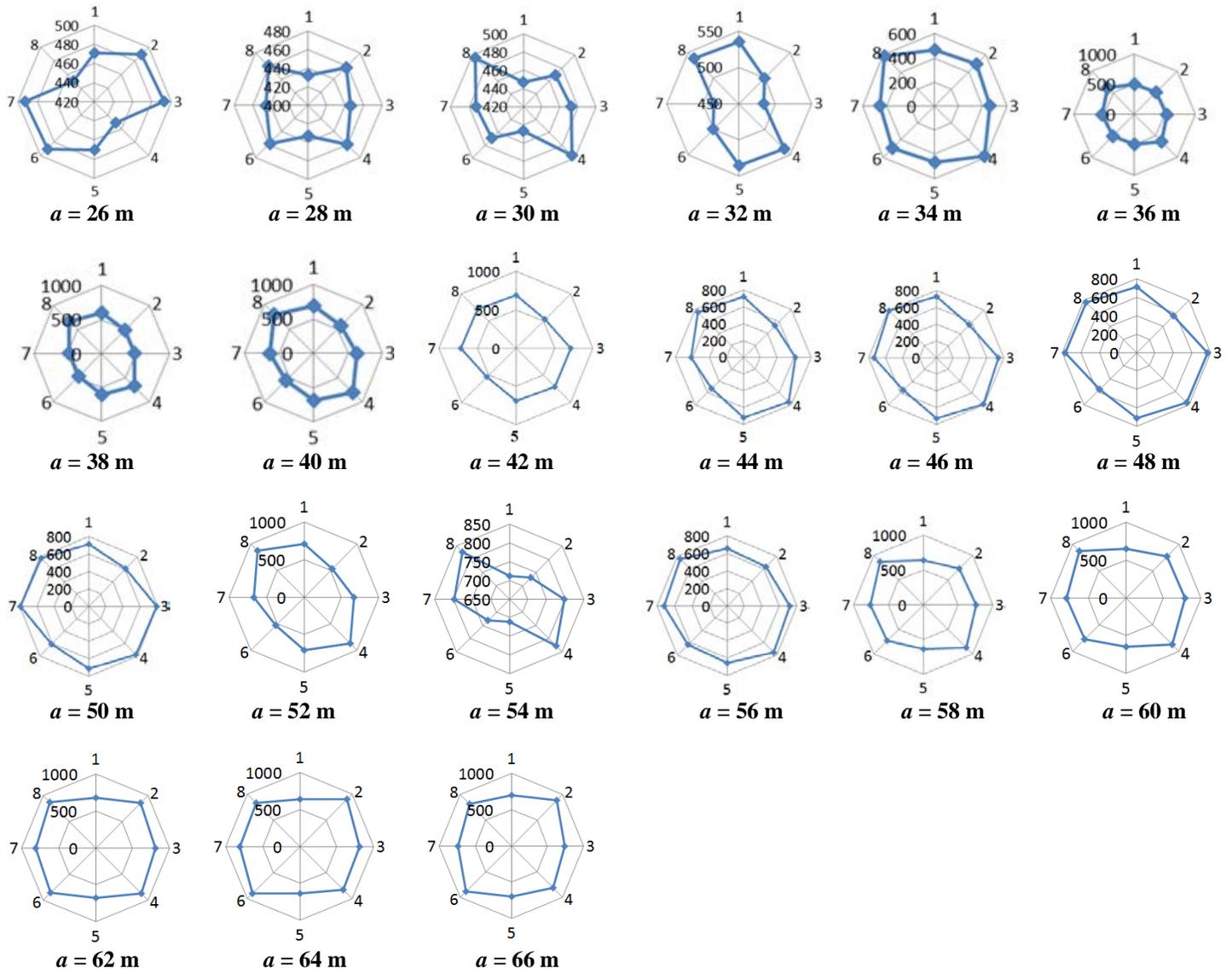


Fig. 4 A pattern of polygon of anisotropy showing how the anisotropy coefficient and the strike direction are determined

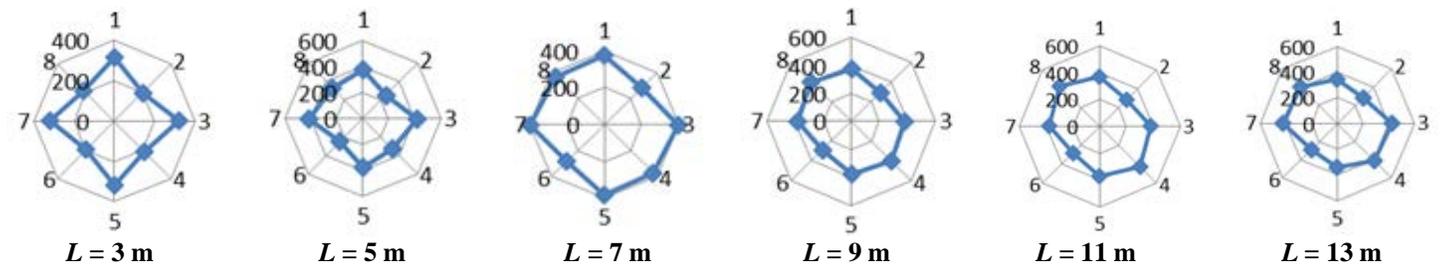
The major axis of the ellipse, which can fit any of such anisotropic polygons, gives the strike direction of the fracture. So in the example shown in Fig. 4, the strike direction is NW-SE etc.

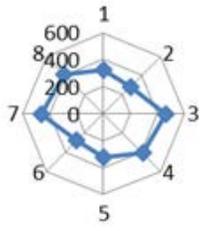




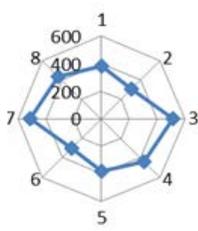
1 – 5 $0^\circ - 180^\circ$ *N – S* 2 – 6 $045^\circ - 225^\circ$ *NE – SW*
 3 – 7 $090^\circ - 270^\circ$ *E – W* 4 – 8 $135^\circ - 315^\circ$ *SE – NW*

Fig. 5 The pattern of Azimuthal apparent resistivity in Ohm-m plotted at different depths with the Wenner Array

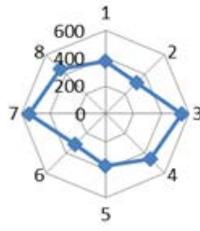




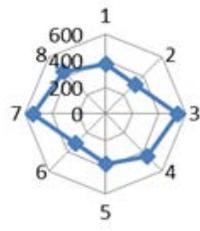
L = 15 m



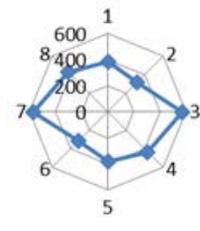
L = 17 m



L = 19 m

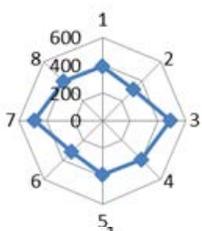


L = 21 m

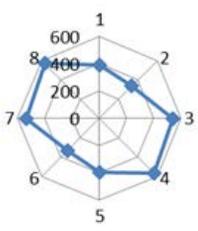


L = 23 m

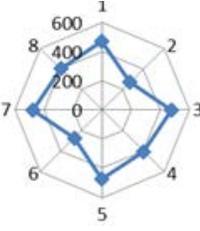
L = 25 m



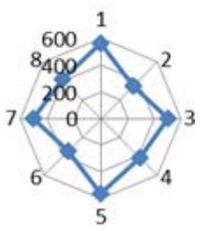
L = 27 m



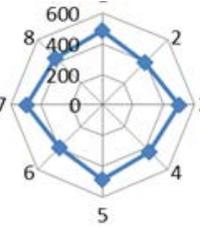
L = 29 m



L = 31 m

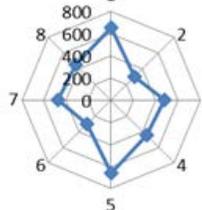


L = 33 m



L = 35 m

L = 37 m



L = 39 m



L = 41 m



L = 43 m

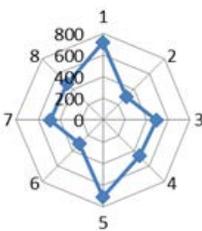


L = 45 m

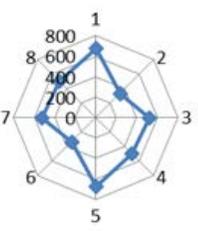


L = 47 m

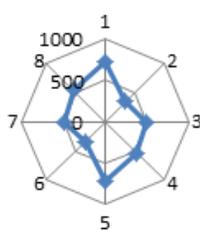
L = 49 m



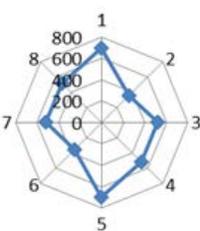
L = 51 m



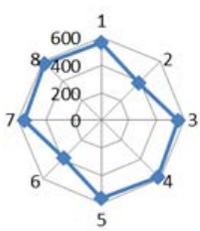
L = 53 m



L = 55 m

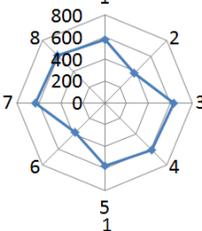


L = 57 m

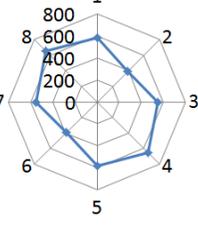


L = 59 m

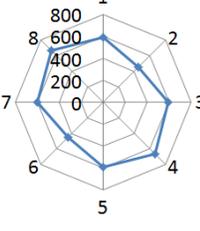
L = 61 m



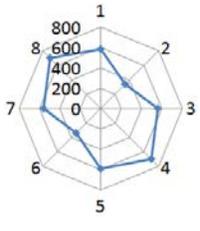
L = 61 m



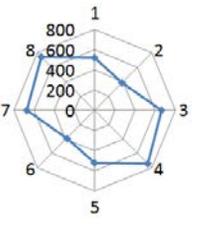
L = 63 m



L = 65 m



L = 67 m



L = 69 m



L = 71 m

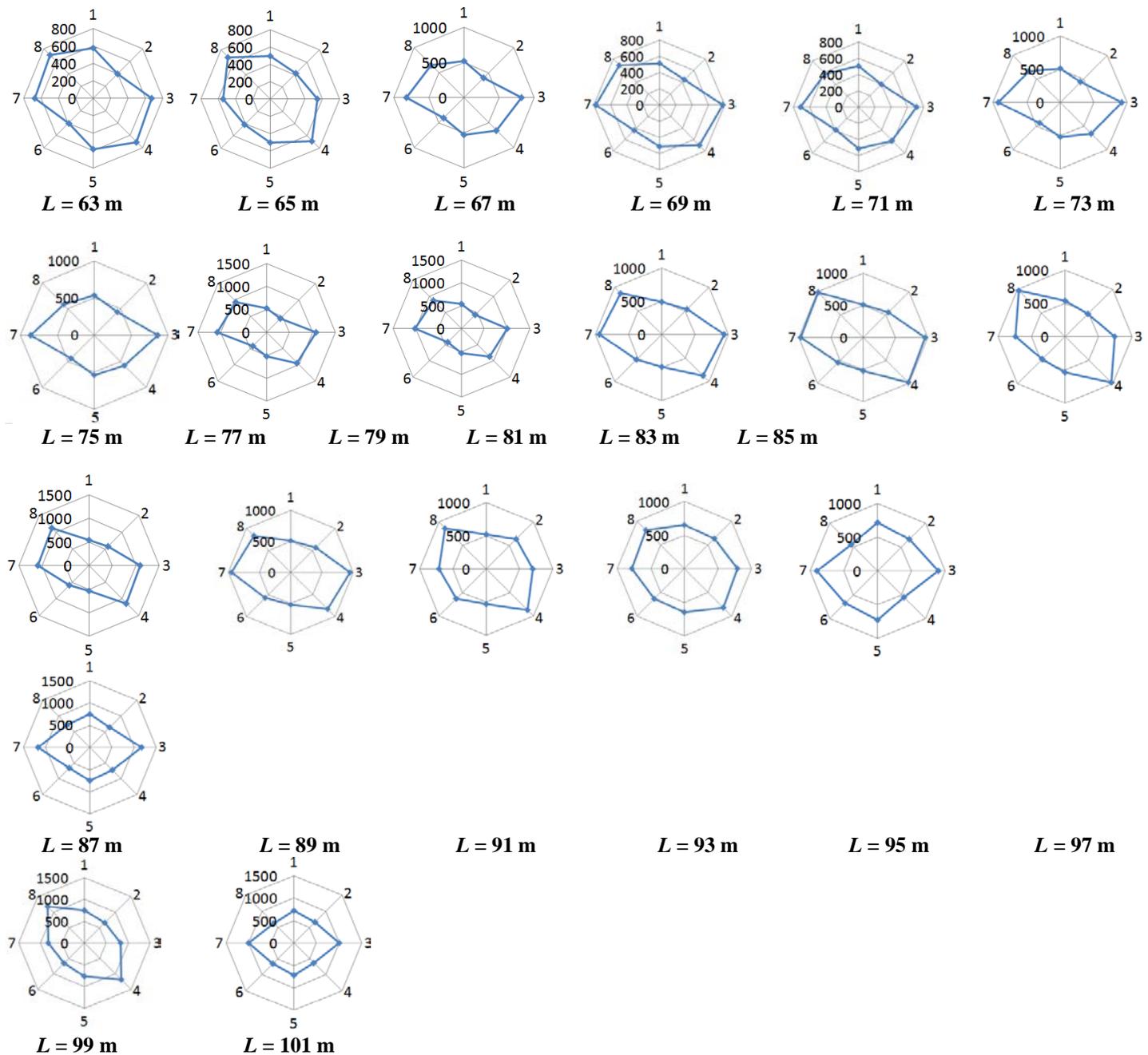


Fig. 6 The pattern of Azimuthal apparent resistivity in Ohm-m plotted at different depths with the Schlumberger Array

Resistivity as function of azimuths is presented as polygons of anisotropy for each electrode spacing (Figs. 5 and 6). Using equation 2, the coefficient of anisotropy (λ) is determined. This parameter is diagnostic of an anisotropy medium. In the above results it varies from 1.030 to 1.308 when the Wenner array was used for azimuthal sounding and for the Schlumberger array, a minimum coefficient of 1.125 and a maximum of 1.588 were achieved.

Anisotropy variation with depth

In the previous section, the coefficient of anisotropy is calculated for each depth of investigation for both the Wenner and Schlumberger array azimuthal measurements. Here, scatter plots of the coefficient of anisotropy versus electrode spacing (depth) are presented (Fig. 7), Wenner and (Fig. 8), Schlumberger.

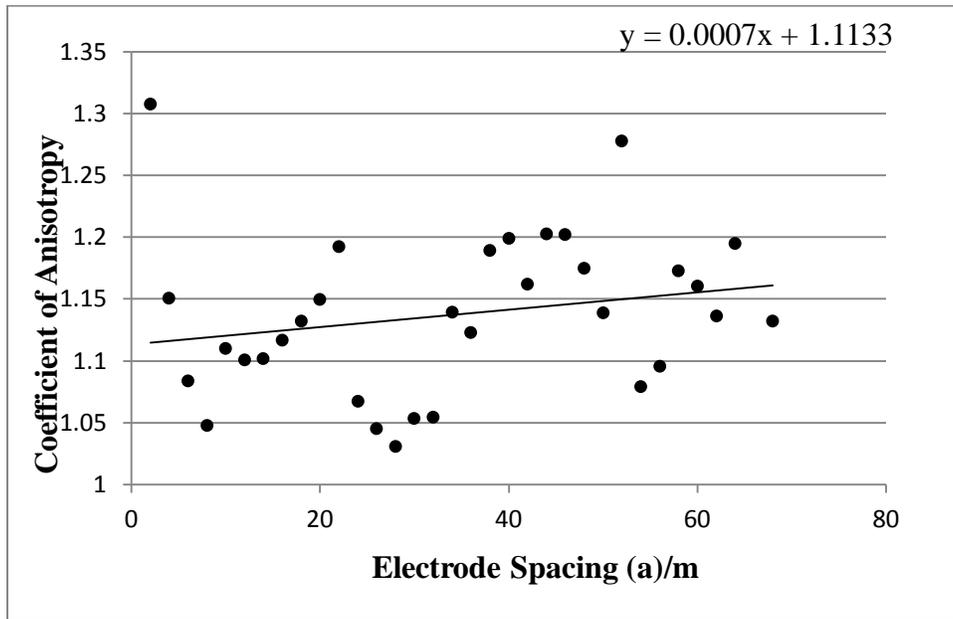


Fig. 7 Wenner Array Scatter plot of Anisotropy versus electrode spacing (depth), with a linear regression model

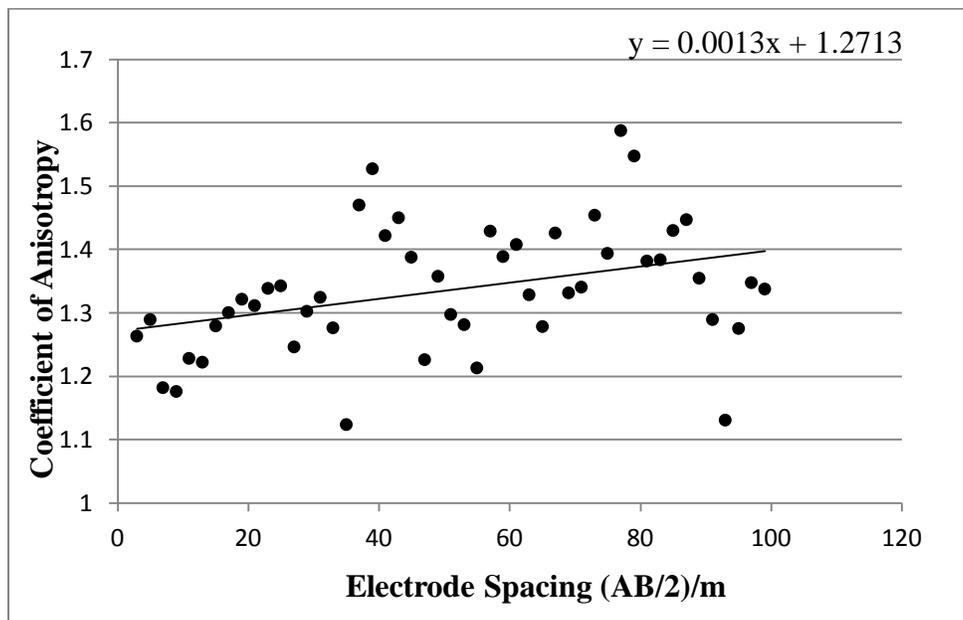


Fig. 8 Schlumberger Array Scatter plot of Anisotropy versus electrode spacing (depth), with a linear regression model

A simple linear regression is fitted to each scatter plot and regression analysis performed to test the significance of the slope – that the variation of coefficient of anisotropy with depth is indeed significant. The Wenner azimuthal resistivity sounding yielded a 0.007 anisotropy change per meter of electrode spacing while the Schlumberger sounding also yielded a 0.0013 coefficient of anisotropy change per meter of electrode spacing.

Using the methods of least squares, a *t*-test of the slope of the regression lines was performed with an Excel worksheet. Fig. 8 shows the worksheet for testing the null hypothesis that the slope of the regression line is 0 purporting that the variation in anisotropy with depth is insignificant.

Wenner Array		Schlumberger Array	
n	33	n	49
r	0.213046	r	0.364272
Sx	19.33908	Sx	28.57738
Sy	0.064472	Sy	0.100193
b	0.00071	b	0.001277
Sy-x	0.064	Sy-x	0.094296
S _b	0.000585	S _b	0.000476
t	1.214063	t	2.681565
Df	31	Df	47
p-value	0.233892	p-value	0.010078
Alpha	0.05	Alpha	0.05
t-crit	2.039513	t-crit	2.011741
sig	no	Sig	Yes
confidence Interval		confidence Interval	
Lower	-0.00048	Lower	0.000319
Upper	-0.00048	Upper	0.002235

Fig. 9 A *t*-test of the slopes of the regression lines for data in Figs. 7 and 8

The inspection of the azimuthal sounding curves in Figs. 2 and 3, gives the first indication of limited anisotropy of the subsurface layers beneath the sounding point. This is demonstrated by the near congruity and trending of the sounding curves.

At each electrode space, the coefficients of anisotropy are calculated for the various azimuths. The results are presented as polygons of anisotropy shown in Figs. 5 and 6. Where these polygons become more elliptic in shapes, the higher the anisotropy of the subsurface. In such instances, the major axis identifies the strike direction of the subsurface feature that giving rise to the anisotropy effect.

It can be observed, again in Figs. 5 and 6, that most of the polygons of anisotropy that assumed elliptic geometry strike in the NW – SE direction. The Schlumberger configuration was more sensitive to anisotropy than the Wenner configuration.

The Wenner azimuthal resistivity sounding yielded a 0.007 anisotropy change per meter of electrode spacing while the Schlumberger sounding also yielded a 0.0013 coefficient of anisotropy change per meter of electrode spacing.

Depth variation in coefficient of anisotropy was studied with both arrays (Figs. 7 and 8). The coefficient of anisotropy change per meter of electrode spacing of 0.007 and 0.0013 obtained for the Wenner and Schlumberger arrays respectively were subject to a student *t*-test at a significance level of 0.05 to ascertain their significance Fig. 9. For the Wenner array, the null hypothesis is sustained and therefore it can be concluded that the population slope is zero and insignificant - anisotropy did not exhibit any significant variation with depth. The hypothesis test performed on the 0.0013 regression slope obtained when the Schlumberger array azimuthal resistivity sounding was done indicated, on the basis of the 0.05 level of significance that the slope is significant. However, the reported confidence interval does not suggest we have very strong evidence the regression relation is significant.

IV. CONCLUSION

Electrical anisotropy resulting from subsurface features which cause current to have preferential flow direction is manifested when a configuration of electrodes is rotated about a fixed point. Using two of the most common conventional collinear electrode arrays, and without any a priori specific site information, this paper has attempted to establish the effectiveness of alpha Wenner and symmetric Schlumberger resistivity soundings in the determination of electrical resistivity anisotropy. It also aimed at quantitatively determining the anisotropy coefficient from both spreads and also to compare their results.

The direction of electrical anisotropy is predominantly in the NW – SE. The Schlumberger array was found to be more sensitive to electrical anisotropy than the alpha Wenner. The coefficient of anisotropy obtained from the survey varies from 1.030 to 1.308 when the Wenner array was used and 1.125 to 1.588 for Schlumberger configuration.

Coefficient of anisotropy variation with depth was found to be insignificant for both configurations, more especially the Wenner. Thus for both arrays, expanding the electrode spacing did not significantly reveal any significant change in the anisotropy.

REFERENCES

- [1] Boadu, F. K. Determining subsurface fracture characteristics from azimuthal resistivity surveys: A case study at Nsawam, Ghana. *GEOPHYSICS* (2005), 70(5):B35
- [2] Bolshakov, D.K., Modin, I.N., Pervago, E.V., Shevnin, V.A. Separation of anisotropy and inhomogeneity influence by the spectral analysis of azimuthal resistivity diagrams. *Proceedings of 3rd EEGS-ES Meeting*. Aarhus, Denmark (1997). P.147-150.
- [3] Bolshakov, D.K., Modin, I.N., Pervago, E.V., Shevnin, V.A. Modeling and interpretation of azimuthal resistivity sounding over two-layered model with arbitrary - oriented anisotropy in each layer. *Proceedings of 60th EAGE Conference*, Leipzig (1998). P110.
- [4] Bolshakov, D.K., Modin, I.N., Pervago, E.V., Shevnin, V.A. New step in anisotropy studies: arrow-type array. *Proceedings of 4th EEGS-ES Meeting*, Barcelona, (1998), p. 857-860.
- [5] Busby, J.P. The effectiveness of azimuthal apparent-resistivity measurements as a method for determining fracture strike orientations. *Geophysical Prospecting*, (2000), 48, 677-695.
- [6] Changchun, Yin. Geoelectrical inversion for a one-dimensional anisotropic model and inherent non-uniqueness *Geophys. J. Int.* 140 (2000), 11, 23
- [7] Habberjam, G.M. Apparent resistivity anisotropy and strike measurement. *Geophys. Prosp.* (1975), 23(1): 211-215.
- [8] Mallik, S. B., Bhattacharya, D. C., & Nag, S. K. Behaviour of fractures in hard rocks-A study by surface geology and radial VES method. *Geoexploration*, (1983), 21(3), 181-189
- [9] Mota, R. S., F. A. Monteiro, A. Mateus, F.O. Marques, A. Conclaves, J. Figueiras and H. Amaral. Granite fracturing and incipient pollution beneath a recent landfill facility as detected by geoelectrical surveys. *J. Appl. Geophys.* (2004), 57(1): 11-22.
- [10] Mousatov, A., Pervago, E., Shevnin, V. New approach to resistivity anisotropic measurements. *Proceedings of SEG 70th Annual Meeting*, Calgary, Alberta, Canada (2000), NSG-P1.5, 4 pp.
- [11] Mousatov, A., Pervago, E., Shevnin, V. Anisotropy determination in heterogeneous media by tensor measurements of the electric field. *Proceedings of SEG 72th Annual Meeting*, Salt Lake City (2004). 4 pp.
- [12] National Academy of Sciences. *Rock Fractures and Fluid Flow: Contemporary Understanding and Applications*. NATIONAL ACADEMY PRESS, Washington, D.C. (1996).
- [13] Pervago, E., Mousatov, A., Shevnin, V. Joint influence of resistivity anisotropy and inhomogeneity on example of a single dipping interface between isotropic overburden and anisotropic basement. *Proceedings of the SAGEEP of conference*. Denver (2001). ERP_7, 10 p.
- [14] Semenov, A.S. Rock anisotropy and electrical fields peculiarities in anisotropic media. *Vestnik of Leningrad University. Ser. Geol. and geography* (1975) N 24, p.40-47, (In Russian).
- [15] Taylor, R.W. and A.H. Fleming. Characterizing jointed systems by azimuthal resistivity surveys. *Groundwater*, (1988), 26(4): 464-474.
- [16] Telford, W.M., Geldard, L.P. and Sheriff, R.E. *Applied Geophysics*. 2nd Edition (1990). Pp 531, 532.
- [17] Watson, K.A. and Barker, R.D. Modelling azimuthal resistivity sounding over a laterally changing resistivity subsurface. *Near Surface Geophysics* (2005) 3, 3-11.

- [18] Watson, K. and Barker, R., 1998. Discriminating between true and pseudo-anisotropic ground using azimuthal resistivity soundings. Proceedings of the 4th EEGS European Section Meeting, Barcelona, Spain (1998), pp. 849-852.
- [19] Sheriff, E. R., 2013. Encyclopedic Dictionary of Applied Geophysics. Fourth Edition.

AUTHORS

First Author – Van-Dycke Sarpong Asare, MSc, Department of Physics, Kwame Nkrumah University of Science and Technology, Kumasi. vsasare.cos@knust.edu.gh

Second Author – Emmanuel Gyasi, BSc, Kwame Nkrumah University of Science and Technology, Kumasi

Third Author – Bismark Fofie Okyere, BSc, Kwame Nkrumah University of Science and Technology, Kumasi

Correspondence Author – Van-Dycke Sarpong Asare, MSc, Department of Physics, Kwame Nkrumah University of Science and Technology, Kumasi. vsasare.cos@knust.edu.gh/ vandycke@yahoo.co.uk (233-244-895283)

Effect of dexmedetomidine with or without butorphanol on the clinico-physiological and haemodynamic stability in dogs undergoing ovariohysterectomy in midazolam and ketamine anaesthesia

Malik Abu Rafee, Prakash Kinjavdekar, Amarpal, H.P. Aithal

Indian Veterinary Research Institute, Izatnagar, India

Abstract- Clinical anaesthetic trial was conducted in mixed breed dogs undergoing ovariohysterectomy to observe the effect of dexmedetomidine and dexmedetomidine with butorphanol, as adjunct to midazolam and ketamine anaesthesia, on the clinico-physiological and haemodynamic stability in midazolam and ketamine anaesthesia. Atropine (0.04 mg kg^{-1}) followed by dexmedetomidine ($20\mu\text{g kg}^{-1}$) after 5 min IM were administered to each animal. Animals were randomised into groups D, DB of eight animals each. In group DB butorphanol (0.1mg kg^{-1}) IM was also administered at the time of dexmedetomidine administration. After 10 min of premedication, anaesthesia was induced with midazolam (0.8 mg kg^{-1}) IV, in all the groups and maintained with 1% ketamine as and when required. Excellent jaw tone relaxation, abolished palpebral reflex with no significant ($P>0.05$) difference between two groups was observed. Heart rate showed an initial increase followed by a decrease, while respiratory rate decreased below the baseline in all the groups. RT decreased significantly ($P<0.05$) below the baseline. SBP, DBP and MAP increased initially in all the groups and then decreased until 120 min interval. However, mean arterial pressure remained above the baseline throughout the observation period in all the groups. Addition of butorphanol did not have significant effects on the clinico-physiological and haemodynamic stability; however, it reduced the amount of ketamine required for maintenance and better sedation.

Index Terms- butorphanol, clinico-physiological, dexmedetomidine, dogs, haemodynamic, midazolam, ovariohysterectomy

I. INTRODUCTION

Dexmedetomidine is a potent and highly selective alpha-2 adrenoceptor agonist with sympatholytic, sedative, amnestic, and analgesic properties (Carollo *et al.*, 2008; Venn *et al.*, 1999) which has been described as a useful and safe adjunct in many clinical applications. It provides a unique "conscious sedation" (patients appear to be asleep, but are readily aroused), analgesia, without respiratory depression. Dexmedetomidine reduces the dose requirements of opioids and anaesthetic agents and attenuates the haemodynamic responses to tracheal intubation and surgical stimuli, besides having organ protective effects against ischemic and hypoxic injury, including

cardioprotection, neuroprotection and renoprotection (Panzer *et al.*, 2009).

Opioids are the most commonly used analgesics to supplement anaesthesia for tolerance of surgical procedures due to their efficacy, rapid onset of action and safety. Butorphanol is an opioid agonist-antagonist with sedative and analgesic properties. It is known to induce mild sedation accompanied by small decreases in arterial blood pressure, heart rate and arterial oxygen tension in dogs. Combinations of butorphanol and alpha-2 adrenoceptor agonists provide reliable and uniform sedation in dogs and cats, although significant decreases in heart and respiratory rates are observed.

Midazolam has modest effects on haemodynamic parameters (Reves *et al.*, 1978). Midazolam can be used as a short-acting intravenous induction agent in human beings (Fragen *et al.*, 1978; Nilsson *et al.*, 2008), owing to its anaesthetic properties i.e. anxiolytic, sedative-hypnogenic, muscle relaxant, and anti-convulsant (Ritcher, 1981), rapid onset of effects and short duration action (Dundee, 1979, Reves *et al.*, 1985). Ketamine also provides cardiovascular stability when given with dexmedetomidine butorphanol preanaesthetized dogs. The objective of this study was to compare the effect dexmedetomidine alone dexmedetomidine with butorphanol on the clinico-physiological and haemodynamic stability in dogs undergoing ovariohysterectomy.

II. METHODOLOGY

The study was designed as randomized, blinded, prospective clinical study, with written and informed owner consent. Permission was taken from the Institute Animal Ethics Committee for conducting the clinical trial. 16 healthy mixed breed female dogs undergoing elective ovariohysterectomy were administered atropine (0.04 mg kg^{-1}) (Tropine; Neon Laboratories, Palghar, Thane, India) and randomly divided into two groups viz. D and DB, each receiving eight animals. In group D, dexmedetomidine ($20\mu\text{g kg}^{-1}$) (Dextomid; Neon Laboratories, Palghar, Thane, India), while in group DB, dexmedetomidine ($20\mu\text{g kg}^{-1}$) and butorphanol (0.1mg kg^{-1}) (Butodol; Neon Laboratories, Palghar, Thane, India) were administered IM after 5 min of atropine administration. Ten minutes after the premedication with dexmedetomidine, anaesthesia was induced with midazolam (0.8mg kg^{-1}) (Mezolam; Neon Laboratories, Palghar, Thane, India) in all the animals. Anaesthesia was

maintained with 1% ketamine, prepared by diluting 5% with required amount of normal saline (Ketmin 50; Themis Medicare Limited, Uttarakhand, India).

Weak time and down time were recorded as the time elapsed from time of injection of drugs to the time of onset of incoordination/ataxia or drowsiness and till animals attained sternal recumbency, respectively. Recovery time was recorded as the time elapsed from injection of drugs to the appearance of pedal reflex. Sternal recumbency time and complete recovery time was recorded as the time elapsed from the injection of drugs until the animal attained sternal recumbency, stood and walked unassisted, respectively. Duration of anaesthesia was recorded as the time elapsed from the time of abolition of pedal reflex to the time of reappearance of the pedal reflex. Extubation time was recorded as the time elapsed from successful intubation to reappearance of laryngeal/coughing reflex.

Palpebral reflex; as a measure of depth of sedation and jaw relaxation; as a measure of muscle relaxation were used to monitor the depth of anaesthesia at 0, 15, 20, 30, 45, 60, 75, 90, 105 and 120 min. Extent of salivation was also recorded at the same intervals. Jaw relaxation and palpebral reflexes and salivation score were scored as shown in table 1.

Heart rate (beats min^{-1}) (HR) was monitored with non-invasive blood pressure (NIBP) monitor (Surgivet®, Smith's medical PM, Inc. Waukesha, USA) from ulnar or digital artery and respiratory rate (breaths min^{-1}) (RR) was measured by counting the excursion of thoraco-abdomen at 0, 15, 20, 30, 45, 60, 75, 90, 105 and 120 min intervals. Rectal temperature was recorded with the help of a digital thermometer. Oxygen saturation of haemoglobin (SpO_2) was measured with pulse oxymeter (GIBSON, India). The sensor was applied on the pinna/ tail tip of the animal after clipping hair at the site and cleaning with 70% alcohol (Huss et al., 1995) to record the base value.

STATISTICAL ANALYSIS

One way ANOVA was used to compare the means of induction time, intubation time, duration of anaesthesia, etc between the groups. Two way ANOVA was used to compare the means/medians at different time intervals among different groups as well as at different time intervals using Proc. GLM of SAS 9.2. The subjective data generated from the scoring of various parameters was analysed using Kruskal Wallis test (Snedecor and Cochran, 1980). Statistical significance was assessed at $p \leq 0.05$.

III. RESULTS

Mean \pm SD values of weak, down, duration of anaesthesia, recovery, extubation, sternal recumbency and complete recovery times in different groups are shown in table 2. The loss of pedal reflex was observed at 5.00 ± 3.12 and 4.75 ± 2.92 mins after administration of midazolam. Laryngeal reflex was lost after 5.25 ± 2.55 , 5.50 ± 1.93 min after administration of midazolam in group D and DB, respectively. Excellent muscle relaxation (fig. 1) was observed from 20 min up to 75 min in group D and up to 60 min in group DB. Thereafter, the muscle tone improved gradually in both the groups. The palpebral reflex (fig. 2) was abolished completely from 20 min up to 75 min in group DB and up to 60 min in group D. Thereafter, the palpebral reflex returned and was

mild to moderate till the end of the observation period. There was no significant ($P > 0.05$) difference between two groups in jaw relaxation and palpebral reflex score at any recording intervals. Salivation was normal in all the animals of different groups at different intervals.

Mean \pm SD values of HR, RR, RT, SBP, DBP and MAP at various time intervals are indicated in fig. 3 to fig. 8. In both the groups, heart rate increased after administration of preanaesthetics and reached the highest value at 15 min interval. Heart rate started decreasing gradually and a significant ($P < 0.05$) decrease was recorded from 75 min onwards as compared to the baseline in group D. In group DB, heart rate increased significantly ($P < 0.05$) at 15 and 20 min. Comparison revealed no significant ($P > 0.05$) differences among the groups except at baseline. Respiratory rate was found significantly below the baseline at 75 min interval in both the groups, however, it was nonsignificantly below the baseline in both the groups at all other intervals in both the groups. Comparison among the groups revealed no significant ($P > 0.05$) difference in RR at any recording time interval. RT decreased significantly ($P < 0.05$) below the baseline after 30 min in group D and after 20 min in group DB. Systolic blood pressure, diastolic blood pressure and mean arterial pressure increased initially in all the groups and then decreased until 120 min interval. In group D, SBP increased nonsignificantly over the baseline up to 60 min, followed by a nonsignificant decrease below the baseline. DBP increased significantly up to 60 min and thereafter, decreased nonsignificantly below the baseline. MBP decreased after the initial significant ($P < 0.05$) increase up to 30 min and remained nonsignificantly increased during the rest of the observation period. In group DB, SBP, DBP and MBP increased significantly ($P < 0.05$) at 20 min and thereafter, increased nonsignificantly throughout the observation period. MAP remained above the baseline throughout the observation period in all the groups. Comparison among different groups revealed that there was no significant ($P > 0.05$) difference in blood pressure between the groups.

IV. DISCUSSION

In the animals of group D, the weak time and down time were almost similar to that reported by Amarpal *et al.* (1996), after the administration of medetomidine/dexmedetomidine in dogs and is due to the onset of action of dexmedetomidine has been attributed to its lipophilic property (Amarpal *et al.*, 1996; Singh *et al.*, 2005). Dexmedetomidine, an isomer of medetomidine was also thought to act in a similar way as medetomidine. Butorphanol is also rapidly absorbed after IM administration to dogs and the decrease in weak time in the animals of group DB as compared to that in group D (although nonsignificant) may be attributable to the expected synergistic interaction of butorphanol with dexmedetomidine. The similar down times in groups DB and group D, was in accordance with the study by Jeff *et al.* (2000) where addition of ketamine or butorphanol to the drug regimen did not shorten the onset of lateral recumbency, compared with administration of medetomidine alone. The slightly shorter induction time in group DB than group D could be attributable to additional sedation due to the addition of opioid in preanaesthesia protocol.

Dexmedetomidine causes very mild to mild depression of the laryngeal reflex because of its hypnotic action due to binding to alpha-2 A adrenoreceptors on the cell membrane of neurons of locus coeruleus and opening of inward rectifying potassium channels, resulting in hyperpolarization of membrane, a key element in production of sedation/hypnosis by alpha-2 agonists (Chiu *et al.*, 1995). Successfully intubation after midazolam injection suggests that complete depression of laryngeal reflex may be due to synergism between midazolam and dexmedetomidine (Bol *et al.*, 2000).

The nonsignificantly shorter duration of anaesthesia and recovery time in group DB can be attributed to lesser amount of ketamine required for maintenance of the anaesthesia in group DB (31.25 mg) than group D (51.25 mg). Longer extubation time was nonsignificantly in group DB than group D may be because of the antitussive property of opioid (Ko *et al.*, 1996). Results of sternal recumbency time in group D supported the observations of Kuusela *et al.* (2000), who reported that dogs administered with dexmedetomidine intravenously at the dose rate of 20µg/kg, were laterally recumbent at 90 min of observation. It has also been reported that dogs given medetomidine and butorphanol regained sternal recumbency after 73.5 ± 19 minutes (Ko *et al.*, 1996). Dogs given medetomidine and ketamine were still unable to rise 120 minutes after drug administration (Moens and Fargetton, 1990). Increased sternal recumbency time in group DB, probably resulted from the synergistic action among dexmedetomidine, butorphanol, midazolam and ketamine, resulting in deeper sedation and reduced metabolic activity to delay redistribution and metabolism of the drugs (Jacobson and Hartsfield, 1993; Ko *et al.*, 2000). The increase in standing recovery time with increase in the number of drugs used could be correlated with the increased sedation and decreased metabolic rate in these groups (Jacobson and Hartsfield, 1993; Ko *et al.*, 2000). Voluntary urination may be attributed to diuretic effect of alpha-2 agonists due to the interference with the action of antidiuretic hormone on the renal tubular cells and collecting ducts which increase the production of urine (Gellai and Edwards, 1988) and/or to the fluid administration. Urination during the surgery can also be related to the pressure on urinary bladder while manipulating with abdominal cavity. Defecation may be attributed to the loss of anal sphincter tone during anaesthesia.

Sluggish jaw tone after the administration of dexmedetomidine alone or with butorphanol was due to alpha-2 agonist inhibition of alpha-2 adrenoreceptors in the interneuron level of spinal cord (Sinclair, 2003). Profound jaw relaxation after midazolam administration can be attributed to the muscle relaxant effect of midazolam which is mediated through glycine receptors in the spinal cord (Ritcher, 1981). Moderate decrease in palpebral reflex observed due to sedation induced by dexmedetomidine (Sabbe *et al.*, 1994). Opioid administration increased the score at 20 min in groups DB. This supports the reliable and uniform sedation obtained in butorphanol and alpha-2 adrenoreceptor agonist combination (Muir *et al.*, 1999 and Ko *et al.*, 1996). opioid related additional sedation might be responsible for delayed reappearance palpebral reflex in group DB. Salivation was not observed in any group at any interval of time. It can be attributed to atropine's antimuscarinic effects (Brock, 2001) and α adrenergic receptor mediated action of

dexmedetomidine which causes decrease in salivation, decrease in secretions and decrease in bowel motility (Gertler *et al.*, 2001).

The significant difference at the baseline in heart rate can be due to the individual variations. Initial increase in HR even after the administration of dexmedetomidine with or without opioid might be attributed to the effect of atropine (Innes and Nickerson, 1975). This is in accordance with the earlier studies in which preemptive administration of atropine was found capable of reversing alpha-2-agonist-induced bradycardia in dogs and caused initial tachycardia (Alibhai *et al.*, 1996). The duration of action of atropine sulphate is only 60 to 90 minutes (Muir, 2007), so the decrease in heart rate recorded after 60 or 70 min may be because of potential effects of alpha-2 agonists and opioids to induce bradycardia (Ko *et al.*, 2000). Bradycardia occurring due to dexmedetomidine is thought to be of parasympathetic origin (Bloor *et al.*, 1992). The results of this study also conformed to the observations of Kuusela (2004) who reported decreased HR after dexmedetomidine administration in dogs. It has also been reported that butorphanol facilitates the increase in parasympathetic tone and thereby contributes to bradycardia (Ko *et al.*, 2000). Midazolam is reported to have a non-significant effect on heart rate (Butola and Singh, 2007). So, the effects on the heart rate might be mostly due to dexmedetomidine which were ameliorated by atropine atleast during the first hour of the study. This supports no significant difference between the groups after significant baseline individual variation.

Decrease in RR might be attributed to combined effect of systemic administration of dexmedetomidine, midazolam and ketamine (Sabbe *et al.*, 1994, Butola and Singh, 2007 and Wright, 1982), but addition of butorphanol does not have any significant effect on RR. Decrease in rectal temperature after the onset of effect might be attributed to decrease in heat production due to decreased muscular activity and due to direct effect of drugs on hypothalamus (Virtanen, 1989). Decrease in rectal temperature is attributed to the activation of alpha-2 C receptors by dexmedetomidine, which mediate hypothermia (Lemke, 2004) in combination with a reduction in muscular activity and BMR (Ponder and Clarke, 1980; MacDonald *et al.*, 1988; Virtanen, 1989). A gradual decrease in rectal temperature following intravenous administration of dexmedetomidine was observed by Raekallio *et al.* (2005); non-significant decrease in RT was also detected in dogs in which midazolam was administered alone (Butola and Singh, 2007). A direct depression of thermoregulatory centre of hypothalamus by ketamine is reported (Wright, 1982). Hypothermia produced by ketamine administration in later stages of the study period might also be due to generalized sedation, reduced metabolic rate, decreased heat production and as a result of general anaesthesia and increased heat loss secondary to cutaneous vasodilation (Lin *et al.*, 1978).

The significant increase in MBP and DBP and nonsignificant increase in SBP after the administration of dexmedetomidine alone or with opioid may be due to high blood concentration of dexmedetomidine and atropine. Anticholinergics are capable of causing hypertension (Alibhai *et al.* 1996) and high plasma levels dexmedetomidine stimulates alpha-2B adrenoreceptors in smooth vessels of blood vessels producing vasoconstriction and consequently hypertension

(MacMillan et al. 1996). The decreases in the BP after significant initial rise may be due to metabolism of dexmedetomidine and resultant low concentrations produce the decrease in blood pressure through alpha-2A stimulation and inhibition of norepinephrine release in autonomic nervous system (MacMillan et al. 1996). Alibhai et al. (1996) has also recorded that medetomidine alone causing a small rise in MAP, which was followed by decrease in the MAP. Midazolam is known to have minimal effects on heart but a significant decrease in arterial pressure has been reported in dogs (Butola and Singh 2007). Midazolam and butorphanol also adds to the decrease in BP after initial rise in this study. Ketamine, on the other hand, produces an increase in cardiac output and heart rate and often produces significant increase in BP (Zielmann et al. 1997). In the present study the overall effect was such that the BP remained either above or nonsignificantly below the base line due to administration of ketamine that combated the expected fall in the BP due to combined action of dexmedetomidine, midazolam and butorphanol.

V. CONCLUSION

Dexmedetomidine and dexmedetomidine-butorphanol produced comparable degree of clinico-physiological and haemodynamic stability under midazolam induction and ketamine maintenance anaesthesia in dogs undergoing elective ovariohysterectomy. However, addition of butorphanol for basal anaesthesia reduced the amount of ketamine required for maintenance and better sedation

APPENDIX

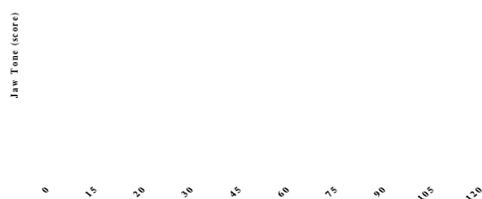


Figure 1: Median \pm SD values (n=16) of score for jaw relaxation in different groups at different time intervals.

Palpebral reflex (score)

Figure 2: Median \pm SD values (n=16) of score for palpebral reflex in different groups at different time intervals.

Heart Rate (bpm)

200.1

Figure 3: Mean \pm SD values (n=24) of heart rate in different groups at different time intervals. *and ‡ indicates significant (p < 0.05) decrease and # and ¥ indicates significant (p < 0.05) increase from base line value in groups D, DB and DP, respectively. \$ indicating significant difference between the groups.

Respiratory Rate (breaths/min)

45.1

Figure 4: Mean \pm SD values (n=16) of respiratory rate in different groups at different time intervals. *and ‡ indicates significant (p < 0.05) decrease and # and ¥ indicates significant (p < 0.05) increase from base line value in groups D, DB and DP, respectively.

Rectal Temperature (°C)

40.0

Figure 5: Mean \pm SD values (n=16) of rectal temperature (°C) in different groups at different time intervals. *and ‡ indicates significant (p < 0.05) decrease and # and ¥ indicates significant (p < 0.05) increase from base line value in groups D, DB and DP, respectively.

SBP (mmHg)

260

Figure 6: Mean± SD values (n=24) of systolic blood pressure in different groups at different time intervals. * and ‡ indicates significant (p < 0.05) decrease and # and ¥ indicates significant (p < 0.05) increase from base line value in groups D, DB and DP, respectively.

DBP (mmHg)

210

Figure 7: Mean± SD values (n=24) of diastolic blood pressure (mmHg) in different groups at different time intervals. * and ‡ indicates significant (p < 0.05) decrease and # and ¥ indicates significant (p < 0.05) increase from base line value in groups D, DB and DP, respectively.

MAP (mmHg)

230

Figure 8: Mean± SD values (n=24) of mean arterial pressure (mmHg) in different groups at different time intervals. *and ‡ indicates significant (p < 0.05) decrease and # and ¥ indicates significant (p < 0.05) increase from base line value in groups D, DB and DP, respectively

Table 1: System of recording of various reflexes and responses used for evaluation of anaesthesia in this study.

Score	Parameters			
	Relaxation of jaw	of Palpebral reflex	Salivation	
0	Animal allowing to open the jaw	not strong (quick blink)	Intact and	No salivation
1	Animal opening of jaws and closes quickly	resists	Intact but weak (slow response)	Mild salivation
2	Less resistance to opening the jaws and closed slowly		Very weak (very slow and occasional)	Moderate salivation
3	No resistance and jaws remain open		Abolished	Excessive salivation

Table 2: Median ±SD of induction time, intubation time, duration of anaesthesia, recovery time, extubation, sternal recumbency and complete recovery times in different groups (n=16).

Group	D	DB
Weak Time (min)	4.38±2.67	3.38±2.00
Down time (min)	4.75±2.38	4.75±2.05
Induction time (min)	5.00±3.12	4.75±2.92
Intubation time (min)	5.25±2.55	5.50±1.93
Duration of anaesthesia (min)	67.38±13.00	64.50±17.20
Recovery time (min)	74.38±12.85	68.00±15.33
Extubation time (min)	69.88±16.92	77.00±20.60
Sternal recumbency time (min)	116.50±12.83	118.88±9.89

Complete recovery time (min) 169.12±68.66 177.00±101.36

REFERENCES

- [1] Alibhai, HIK, Clarke, KW and Lee, YH. Cardiopulmonary effects of combinations of medetomidine hydrochloride and atropine sulphate in dogs. *Vet. Rec.*, 1996; 138:11-13.
- [2] Amarpal, Pawde, AM, Singh, GR, Pratap, K. and Kumar, N. Clinical evaluation of medetomidine with or without pentazocine in atropinized dogs. *Indian J. Anim. Sci.*, 1996; 66(3): 219-222.
- [3] Bloor, BC, Frankland, M, Alper, G, Raybould, D, Weitz, J and Shurtliff, M. Hemodynamic and sedative effects of Dexmedetomidine in dog. *J. Pharmacol. Exp. Therap.*, 1992; 263: 690-697.
- [4] Bol, CJJG, Vogelaar, PW, Tang, JP and Mandema, JW. Quantification of pharmacodynamic interactions between dexmedetomidine and midazolam in the rat. *J. Pharmacol. Exp. Therap.*, 2000; 294:347-355.
- [5] Brock, K A. Preanaesthetic use of atropine in small animals. *Aust. Vet. J.*, 2001;79: 24-25.
- [6] Butola, V and Singh, B. Midazolam as tranquilizer in dogs. *Indian Vet. J.*, 2007; 84: 1141-1145.
- [7] Carollo, DS, Nossaman, BD and Ramadhyani, U. Dexmedetomidine: a review of clinical applications. *Curr. Opin. Anaesthesiol.*, 2008; 21:457-461.
- [8] Chiu, TH, Chen, MJ, Yang, YR, Yang, JJ and Tang, FI. Action of dexmedetomidine on rat coeruleus neurons: intracellular recording in-vitro. *Euro. J. Pharmacol.*, 1995; 285:261-268.
- [9] Dundee, JW. New intravenous anaesthetics. *Br. J. Anaesth.*, 1979; 51: 641-648.
- [10] Fragen, RJ, Gahl, F and Caldwell, N. A water-soluble benzodiazepine, RO 21-3981, for induction of anesthesia. *Anesthesiol.*, 1978; 49:41-43.
- [11] Gellai, M and Edwards, RM. Mechanism of alpha-2 adrenoceptor agonist-induced diuresis. *Am. J. Physiol.*, 1988; 255: 317-323.
- [12] Gertler, R, Brown, HC, Mitchell, DH, Silvius, EN. Dexmedetomidine: a novel sedative analgesic agent. *BUMC proceedings.*, 2001;14:13-21.
- [13] Innes, IR, Nickerson, M. Atropine, scopolamine and related antimuscarinic drugs, in Goodman, LS, Gilman, A. *Pharmacological basis of therapeutics* (5th Edn), New York, Macmillan Publishing Co. Inc. 1975; PP: 514-532.
- [14] Jacobson, JD and Hartsfield, SM. Cardiorespiratory effects of intravenous bolus administration and infusion of ketamine midazolam in dogs. *Am. J. Vet. Res.*, 1993 54:1710-1714.
- [15] Jeff, CHK, Steven, MF and Ronald, EM. Sedative and cardiorespiratory effects of medetomidine, medetomidine-butorphanol, and medetomidine-ketamine in dogs. *J. Am. Vet. Med. Assoc.*, 2000; 216:1578-1583.
- [16] Ko, JCH, Bailey, JE and Pablo, LS. Comparison of sedative and cardiorespiratory effects of medetomidine and a medetomidine butorphanol combination in dogs. *Am. J. Vet. Res.*, 1996; 57:535-540.
- [17] Ko, JCH, Fox, SM and Mandsager, RE. Sedative and cardiorespiratory effects of medetomidine, medetomidine-butorphanol, and medetomidine-ketamine in dogs. *J. Am. Vet. Med. Assoc.*, 2000; 216:1578-1583.
- [18] Kuusela, E. Dexmedetomidine and levomedetomidine, the isomers of medetomidine, in dogs. *Academic Dissertation, Helsinki, Finland 2004.*
- [19] Kuusela, E, Raekallio, M, Anttila, M, Falck, I, Mölsä, S and Vainio, O. Clinical effects and pharmacokinetics of medetomidine and its enantiomers in dogs. *J. Vet. Pharmacol. Therap.*, 2000; 23: 15-20.
- [20] Lemke, KA. Perioperative use of selective alpha-2 agonists and antagonists in small animals. *Can. Vet. J.*, 2004; 45:475-480.
- [21] Lin, MT, Chen, CF and Pang, IH. Effect of ketamine on thermoregulation in cats. *Can. J. Physiol. Pharmacol.*, 1978; 56:963-967.
- [22] MacDonald, E, Scheinin, H and Scheinin, M. Behavioural and neurochemical effects of medetomidine, a novel veterinary sedative. *Eur. J. Pharmacol.*, 1988; 158:119-127.
- [23] MacMillan, LB, Hein, L, Smith, MS, Piascik, MT and Limbird, LE. Central hypotensive effects of alpha-2 adrenergic receptor subtype. *Sci.*, 1996; 273: 801-803.

- [24] Moens, Y and Fargetton, XA. Comparative study of medetomidine/ketamine and xylazine/ketamine anaesthesia in dogs. *Vet. Rec.*, 1990; 127: 567-571.
- [25] Muir, WW. Considerations for General Anesthesia. In: Tranquilli, WJ, Thurmon, J C, Grimm, K A, eds. *Lumb & Jones's Veterinary Anesthesia and Analgesia* (4th Edn), Blackwell Publishing Ltd, Oxford. 2007; PP:15-16.
- [26] Muir, WW, Ford, JL, Karpa, GE. Effects of intramuscular administration of low doses of medetomidine and medetomidinebutorphanol in middle-aged and old dogs. *J. Am. Vet. Med. Assoc.*, 1999; 215:1116-1120.
- [27] Nilsson, A, Tamsen, P and Persson. Midazolamfentanyl anesthesia for major surgery. Plasma levels of midazolam during prolonged total intravenous anaesthesia. *Anesthesiol.*, 2008;12: 23-28.
- [28] Panzer, O, Moitra, V and Sladen, RN. Pharmacology of sedative-analgesic agents: dexmedetomidine, remifentanyl, ketamine, volatile anesthetics, and the role of peripheral mu antagonists. *Crit. Care. Clin.*, 2009; 25:451-469.
- [29] Raekallio, MR., Kuusela, EK, Lehtinen, ME, Tykkäläinen, MK, Huttunen, P and Westerholm, FC. Effects of exercise-induced stress and dexamethasone on plasma hormone and glucose concentrations and sedation in dogs treated with dexmedetomidine. *Am. J. Vet. Res.*, 2005; 66(2): 260-264.
- [30] Reves, JG, Corssen, G and Holcomb, C. Comparison of two benzodiazepines for anaesthesia induction: Midazolam and Diazepam. *Can. Anaesth. Soc. J.*, 1978; 25: 211-214.
- [31] Reves, JG, Fragen, RJ, Vinik, H.R. and Greenblatt, DJ. Midazolam: pharmacology and uses. *Anesthesiol.*, 1985; 62: 310-324.
- [32] Ritcher, JJ. Current theories about the mechanism of action of benzodiazepines and neuroleptic drugs. *Anesthesiol.*, 1981; 54: 66-72.
- [33] Sabbe, MB, Penning, JP, Ozaki, GT and Yaksh, TL. Spinal and systemic action of the alpha-2 receptor agonist dexmedetomidine in dogs. *Anesthesiol.*, 1994; 80: 1057-1072.
- [34] Sinclair, MD. A review of the physiological effects of alpha-2 agonists related to the clinical use of medetomidine in small animal practice. *Can. Vet. J.*, 2003; 44: 885-897.
- [35] Singh, V, Amarpal, Kinjavdekar, P, Aithal, HP and Pratap, K. Medetomidine with ketamine and bupivacaine for epidural analgesia in buffaloes. *Vet. Res. Commun.*, 2005; 29(1): 1-18.
- [36] Venn, RM, Bradshaw, CJ and Spencer, R. Preliminary UK experience of dexmedetomidine, a novel agent for postoperative sedation in the intensive care unit. *Anaesth.*, 1999; 54:1136-1142.
- [37] Virtanen, R. Pharmacological profiles of medetomidine and its antagonist, atipamezole. *Acta Vet. Scand.*, 1989; 85(suppl): 29-37.
- [38] Wright, M. Pharmacological effects of ketamine and its uses in veterinary medicine. *J. Am. Vet. Med. Assoc.*, 1982; 182:1462-1471.
- [39] Zielmann, S, Kazmaier, S, Schull and Weyland, A. S-(+)- ketamine and circulation. *Anesthesist*, 1997; 46: 43-46

AUTHORS

First Author – Malik Abu Rafee. Veterinary Doctor DEPT. of AH, J & K India, 192212. M.V.Sc: Veterinary Surgery Division, Indian Veterinary Research Institute Izatnagar, India, 243122, rafee188@gmail.com

Second Author – Prakash Kinjavdekar. Principal Scientist, Veterinary Surgery Division, Indian Veterinary Research Institute Izatnagar, India, 243122, pk@ivri.res.in

Third Author – Amarpal. Principal Scientist Veterinary Surgery Division, Indian Veterinary Research Institute Izatnagar, India, 243122. amarpal@ivri.res.in

Fourth Author – Hari Prasad Aithal. Principal Scientist, Veterinary Surgery Division, Indian Veterinary Research Institute Izatnagar, India, 243122. aithal@ivri.res.in

Corresponding author: Dr. Malik Abu Rafee. rafee188@gmail.com.

Fingerprint Recognition System for Matching

Manmeet Kaur Virdi

Department Of Electronics And Telecommunication, Chouksey Engineering College, Bilaspur(C.G.)

Abstract- Fingerprint Recognition refers to the automated method of verifying a match between two human fingerprints. Fingerprints are one of many forms of biometrics used to identify individuals and verify their identity. Everyone is known to have unique, immutable fingerprints. Fingerprint recognition algorithm extract's primarily uniqueness of the images obtained from the fingerprint. Fingerprint Recognition is a widely popular but a complex pattern recognition problem. Among all the biometric techniques, fingerprint-based identification is the oldest method which has been successfully used in numerous applications. A fingerprint is made of a series of ridges and furrows on the surface of the finger. The uniqueness of a fingerprint can be determined by the pattern of ridges and furrows as well as the minutiae points. Minutiae points are local ridge characteristics that occur at either a ridge bifurcation or a ridge ending. The information contained in a fingerprint can be categorized into three different levels, namely, Level 1 (pattern), Level2 (minutia points), and Level 3 (pores and ridge contours). Despite their discriminative power, the Level 3 features are barely used by the vast. Majority of contemporary automated fingerprint authentication systems which rely mostly on minutiae features. In this thesis the above mentioned techniques have been addressed and a new approach of identification of minutia term's with bifurcation, termination and orientation has been proposed. In our thesis extraction of minutia terms from the image is developed using termination and bifurcation process and elimination of false minutia from the image is carried out using distance formulae's. All those minutiae points are thus undergone with orientation characteristics' which gives the determination more powerful in case of image sizing and plasticity. All these terms are stored in a user profile for matching .Results and testing is performed by taking different user profiles.

Index Terms- Fingerprint, Image Enhancement, Minutiae Extraction.

1. INTRODUCTION

Biometric based recognition, or biometrics, is the science of identifying, or verifying the identity of, a person based on physiological and/or behavioral characteristics .Physiological traits are related to the physiology of the body and mainly include Fingerprint, face, DNA, ear, iris, retina, and hand and palm geometry. Behavioral traits are related to behavior of a person and examples include signature, typing rhythm, gait, voice etc. Biometric recognition offers many advantages over traditional PIN number or password and token-based (e.g., ID cards) approaches. A biometric trait cannot be easily transferred, forgotten or lost, the rightful owner of the biometric template can

be easily identified, and it is difficult to duplicate a biometric trait.

There are a number of desirable properties for any chosen biometric characteristic.

These include:

1. *Universality*: Every person should have the characteristic.
2. *Uniqueness*: No two persons should be the same in terms of the biometric characteristic.
3. *Permanence*: The biometric characteristics should not change, or change minimally, over time.
4. *Collectability*: The biometric characteristic should be measurable with some (practical) sensing device.
5. *Acceptability*: The user population and the public in general should have no (Strong)objection to the measuring/collection of the biometric trait.

The effectiveness of a biometric system can be judged by following characteristics:

1. *Performance* : This refers to the achievable recognition accuracy, speed, robustness, the resource requirements to achieve the desired recognition accuracy and speed, as well as operational (work environment of individual, e.g., manual workers may have a large number of cuts and bruises on their fingerprints) or environmental factors (humidity, illumination etc.) that affect the recognition accuracy and speed .
2. *Scalability* : This refers to the ability to encompass large number of individuals without a significant decrease in the performance.
3. *Non-invasiveness* : This refers to the ease with which the information can be captured from individuals, without damaging an individual's physical integrity and ideally without special preparations by/of an individual.
4. *Circumvention* : This refers to the degree to which the system is resistant to spoofs or attacks.

A practical biometric system should meet the specified recognition accuracy, speed, and resource requirements, be harmless to the users, be accepted by the intended population, and be sufficiently robust to various fraudulent methods and attacks to the system.

Fingerprint Representation

The types of information that can be collected from a fingerprint's friction ridge impression can be categorized as Level 1, Level 2, or Level 3 features as shown in Fig 1.1. At the global level, the fingerprint pattern exhibits one or more regions where the ridge lines assume distinctive shapes characterized by high curvature, frequent

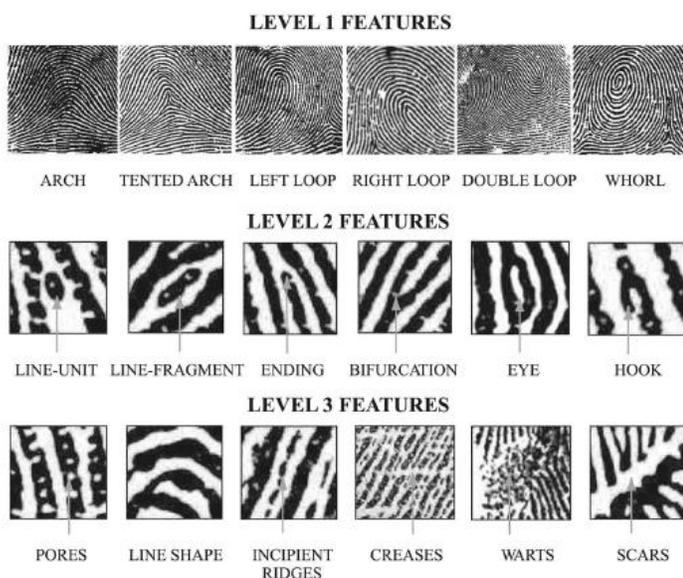


Fig 1.1: Fingerprint features at Level 1, Level 2 and Level 3

termination, etc. These regions are broadly classified into arch, loop, and whorl. The arch, loop and whorl can further be classified into various subcategories. Level 1 features comprises these global patterns and morphological information. They alone do not contain sufficient information to uniquely identify fingerprints but are used for broad classification of fingerprints. Level 2 features or minutiae refers to the various ways that the ridges can be discontinuous. These are essentially Galton characteristics, namely ridge endings and ridge bifurcations. A ridge ending is defined as the ridge point where a ridge ends abruptly. A bifurcation is defined as the ridge point where a ridge bifurcates into two ridges. Minutiae are the most prominent features, generally stable and robust to fingerprint impression conditions. The distribution of minutiae in a fingerprint is considered unique and most of the automated matchers use this property to uniquely identify fingerprints. Uniqueness of fingerprint based on minutia points has been quantified by Galton. Statistical analysis has shown that Level 2 features, have sufficient discriminating power to establish the individuality of fingerprints.

Level 3 features are the extremely fine intra ridge details present in fingerprints. These are essentially the sweat pores and ridge contours. Pores are the openings of the sweat glands and they are distributed along the ridges. Studies have shown that density of pores on a ridge varies from 23 to 45 pores per inch and 20 to 40 pores should be sufficient to determine the identity of an individual. A pore can be either open or closed, based on its perspiration activity. A closed pore is entirely enclosed by a ridge, while an open pore intersects with the valley lying between two ridges as shown in Fig 1.2. The pore information (position, number and shape) are considered to be permanent, immutable and highly distinctive but very few automatic matching techniques use pores since their reliable extraction requires high resolution and good quality fingerprint images. Ridge contours contain valuable information. Level 3 information including ridge width and edge shape. Various shapes on the friction ridge edges can be classified into eight categories, namely, straight, convex, peak, table, pocket, concave, angle, and others as shown

in Fig 1.3. The shapes and relative position of ridge edges are considered as permanent and unique.

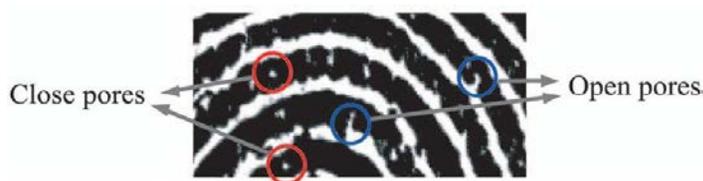


Fig 1.2: Open and closed pores

1	2	3	4	5	6	7
Straight	Convex	Peak	Table	Pocket	Concave	Angle

Fig 1.3: Characteristics of ridge contours and edges

PROBLEM IDENTIFIED AND APPROACH

Fingerprint recognition is a complex pattern recognition problem. It is difficult to design accurate algorithms capable of extracting salient features and matching them in a robust way, especially in poor quality fingerprint images and when low-cost acquisition devices with small area are adopted. There is a popular misconception that automatic fingerprint recognition is a fully solved problem since it was one of the first applications of machine pattern recognition. On the contrary, fingerprint recognition is still a challenging and important pattern recognition problem. The real challenge is matching fingerprints affected by:

Matching partial fingerprints presents several problems:

- the number of minutia points available in such prints is few, thus reducing its discriminating power;
- uncontrolled impression environments result in unspecified orientations of partial fingerprints; and
- the elasticity of human skin and humidity can cause distortions.

The challenges faced in implementation of matching systems that deal with partial or incomplete fingerprints are outlined in Fig 1.1. Since only a small number of feature points are present on a partial fingerprint, the decision making based just on the number of matched feature points is prone to failure.

In this thesis an approach has been presented which addresses the various issues and challenges in Fingerprint matching. The aim is to reduce the error rates, namely False Acceptance Rate (FAR) and False Rejection Error (FRR) in the existing Fingerprint matching algorithms. In first stage image extraction where binarization and thinning of image is carried out by setting and thresholding image constituents. After thinning minutia detection is done by 3X3 window pixel determination for bifurcation and termination of ridges. Again spurious minutia is suppressed by using Euclidean distance formulae and ROI by which false minutia is suppressed. Orientation of minutia is also carried out for both bifurcation and termination which gives algorithm a solid foundation for matching process. Results are processed and a text file with the details is saved for a template.

We introduce various fingerprint representations and provide a general review

Of image enhancement, feature extraction, and matching techniques that are used in Minutiae-based fingerprint recognition systems.

Global Ridge Pattern

This representation relies on the ridge structure, global landmarks and ridge pattern characteristics. Such as the singular points, ridge orientation map, and the ridge frequency map. This representation is sensitive to the quality of the fingerprint images. However, the discriminative abilities of this representation are limited due to absence of singular points.

Local Ridge Detail

This is the most widely used and studied fingerprint representation. Local ridge details are the discontinuities of local ridge structure referred to as *minutiae*. Sir Francis Galton (1822-1922) was the first person who observed the structures and permanence of minutiae. Therefore, minutiae are also called "Galton details". They are used by forensic experts to Match two fingerprints. There are about 150 different types of minutiae categorized based on their configuration. Among these minutiae types, "ridge ending" and "ridge bifurcation" are the most used, since all other types of minutiae can be seen as the combinations of "ridge endings" and "ridge bifurcations". Some minutiae are illustrated in Fig 1.4. The American National Standards Institute-National Institute of Standard and Technology (ANSI-NIST) proposed a minutiae-based fingerprint representation. It includes minutiae location and orientation. The minutia orientation is defined as the direction of the underlying ridge at the minutia location (Fig 1.5). Minutiae-based fingerprint.

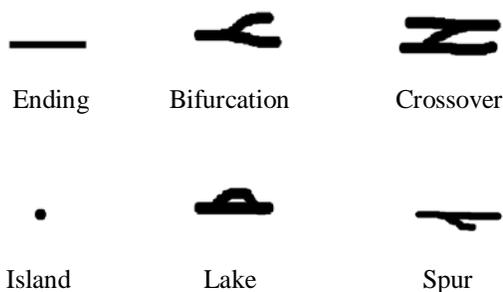
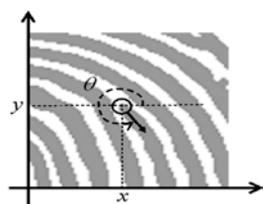
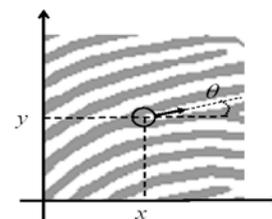


Fig 1.4: Some of the common minutiae types.

representation also has an advantage in helping privacy issues since one cannot reconstruct the original image from using only minutiae information. Minutia is relatively stable and



(a)



(b)

Fig 1.5: (a) A ridge ending minutia: (x,y) are the minutia coordinates; theta is the minutia's orientation; (b) A ridge bifurcation minutia: (x,y) are the minutia coordinates; theta is the minutia's orientation.

robust to contrast, image resolutions, and global distortion when compared to other representations. However, to extract the minutiae from a poor quality image is not an easy task.



Fig 1.5: A portion of a fingerprint where sweat pores (white dots on ridges) are visible.

Today, most of the automatic fingerprint recognition systems are designed to use minutiae as their fingerprint representations.

Intra-ridge Detail

On every ridge of the finger epidermis, there are many tiny sweat pores (Fig 1.5). Pores are considered to be highly distinctive in terms of their number, positions, and shapes. However, extracting pores is feasible only in high-resolution fingerprint images (for example 1000 DPI) and with good image quality. Therefore, this kind of representation is not practical for most applications.

2. SOFTWARE USED

In this project we had used MATLAB.

The MATLAB high-performance language for technical computing integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include

- Math and computation
- Algorithm development

- Data acquisition
- Modeling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics
- Application development, including graphical user interface building

MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. It allows you to solve many technical computing problems, especially those with matrix and vector formulations.

Images in Matlab

This worksheet is an introduction on how to handle images in Matlab. When working with images in Matlab, there are many things to keep in mind such as loading an image, using the right format, saving the data as different data types, how to display an image, conversion between different image formats, etc. This worksheet presents some of the commands designed for these operations. Most of these commands require the *Image processing tool box* installed with Matlab. To find out if it is installed, type `ver` at the Matlab prompt. This gives a list of what tool boxes that are installed on the system.

Supported Formats

The following image formats are supported by Matlab:

- BMP
- HDF
- JPEG
- PCX
- TIFF
- XWB

Working formats in Matlab

If an image is stored as a JPEG-image on disc firstly read it into Matlab. However, in order to start working with an image, for example perform a wavelet transform on the image, it is must convert it into a different format.

RGB COLOR MODEL

A representation of additive color mixing. Projection of primary color lights on a screen shows secondary colors where two overlap; the combination of all three of red, green, and blue in appropriate intensities makes white. An RGB image, along with its separate R, G and B components.

Grayscale

A gray scale or greyscale is an image in which the value of every picture element is a single sample, that is, it carries only intensities information. Images of this sort, are also known as black and white, are composed exclusively of shades of gray value, varying from black at the weakest intensity to white at the strongest.

Grayscale as single channels of multichannel color images

Color images are often built of several stacked color channels, each of them representing value levels of the given channel. For example, RGB images are composed of three independent channels for red, green and blue primary color components; CMYK images have four channels for cyan, magenta, yellow and black ink plates, etc.

3. RESULT AND CONCLUSION

In reference to the idea propose in IEEE journal *Fingerprint Reconstruction: From minutiae to Phase*, Fingerprint reconstruction is carried out from the minutiae template to phase image, which is then converted into grayscale image. Reconstructed image thus eliminate false minutiae terms that corresponds to minutiae. Our thesis is centered upon collection of minutiae terms on the bases of

1. Ridge bifurcation and endings
2. False minutiae rejection based on distance from ridges.
3. Orientation field of minutiae terms based on
 - a) Termination
 - b) Bifurcation

All these data sets are then reutilized in a manner for direct verification of fingerprint and reconstruction of phase image as describe by the paper. Among all these things Region of Interest of the image is carried out in a autonomous way, which makes the work fitted to reconstruction and recognition phases further.

ACKNOWLEDGMENT

Expression of giving thanks are just a part of those feelings which are too large for words, but shall remain as memories of wonderful people with whom I have got pleasure of working during the completion of project.

College is an organization which trains a lot of technical trainee. They not only train the students but they change the entries prospect of our life. I am grateful to “**CHOUKSEY ENGINEERING COLLEGE**” which helped me to do so.

I would like to thank our **HOD** Mr. Rahul Gedam and our guide Mr. Sachin Meshram for their never ending support and motivation and also their helping nature towards the student.

I have also taken the opportunity to thank our **OSD** Mr. S.K. Kaushik for providing us good facility for successful completion for our project.

This is never ending, so I give thanks to all the persons who have directly or indirectly helped me to achieve success in my endeavor.

REFERNCES

- [1] International Biometric Group. Analysis of Level 3 Features at High Resolutions. <http://level3tk.sourceforge.net/>, 2008.
- [2] Jianjiang Feng “ Combing minutiae descriptors for fingerprint matching” Pattern recognition 41, pp. 342 – 352, 2008.
- [3] Anil Jain, Arun Ross, Salil Prabhakar “ Fingerprint matching using minutiae and texture features” appeared in Proc. Of ICIP, pp. 282-285.
- [4] Muhammad Umer Muni, Dr. Muhammad Younas javed “Fingerprint matching using Gabor filter” National conference on emerging technologies, paper no. 3, pp. 147 – 151.
- [5] A. K. Jain, S. Prabhakar “An introduction to biometric recognition” IEEE Transaction Vol. 14, Issue -1, pp.4 -20, January 2004.
- [6] Smital D. Patil, Shailaja A. Patil “Fingerprint recognition using minutia matching” World journal science and technologies 2(4) ISSN : 2231-2587, pp.178 -181, 2012.
- [7] Arun Ross, Anil Jain, James Reisman “ A hybrid fingerprint matcher” appeared in ICPR, august 11 -15, 2002.
- [8] Jianjiang Feng Anil K jain Fingerprint Reconstruction:From Minutae to phase IEEE Transactions on pattern analysis and machine intelligence, Vol. 33, No.2, February 2011.

- [9] Mrs. Hemlata Patel, Pallavi Asrodia “Fingerprint matching using two methods” International Journal of Engineering Research application, Vol. 2, Issue-3, ISSN : 2248 -9622, pp.857 -860, 2012.
- [10] Ridges and Furrows - history and science of fingerprint identification, technology and legal issues. <http://ridgesandfurrows.homestead.com/fingerprint.html>.
- [11]Anil Jain, Lin Hong, and Ruud Bolle, “On-Line Fingerprint Verification”, IEEE Transactions on Pattern Analysis and Machine Intelligence, 19(4):302-314, 1997.
- [12] Miroslav Krlk and Ladislav Nejman, “ Fingerprints on artifacts and historical Items: examples and documents”, Journal of Ancient Fingerprints, August2007.
- [13] H. Faulds. On the skin-furrows of the hand. Nature, 22:605, 1880.
- [14] Francis Galton. Fingerprints. Macmillan, London, 1892.
- [15] G. S. Sodhi and Jasjeet Kaur, “The forgotten Indian pioneers of fingerprint Science”, Current Science, 88(1), January 2005.
- [16] E. Locard, Les Pores et L “Identification Des Criminels Biologica: Revue Scientifique de Medicine”, pg. no.- 357-365, 1912.

AUTHORS

Manmeet Kaur Virdi, MTech Scholar, Chouksey Engineering College, meetele1010@gmail.com

Future Generation Ultra Supercomputing 256×256 Bits Multiplier for Signed-Unsigned Number

Ravindra P Rajput *, M. N Shanmukha Swamy **

* Electronics and Communications Engineering, JSS Research Foundation, Mysore University, Mysore, Karnataka, India.

** Electronics and Communications Engineering, SJCE, Mysore, Karnataka, India.

Abstract- With the future 1 nm Hybrid CMOS technology, we proposed the Future Generation Ultra Supercomputing 256×256 Bits Multiplier for Signed-Unsigned Number. The Hybrid CMOS consists of the CMOS and Complimentary Pass Transistor Logic (CPTL). With the 1 nm future technology the various parameters predicted are the critical path delay of 0.1 ns (10 GHz), chip area of $136.23 \mu\text{m}^2$ and the power dissipation of $1171.4 \mu\text{W}$.

Index Terms- MMBE, CPTL, PPG, VCA, PPRT, CLCSA, CMOS Technology.

I. INTRODUCTION

Future generation ultra supercomputers and requires ultra high speed multipliers. The matrix data multiplication by the supercomputers has wide range of applications such as weather forecasting, oil and gas exploration under the sea, molecular modeling, DNA testing etc. Supercomputer uses the concept superscalar; in this technique up to 8 instructions can be fetched and executed in parallel. There can be more than two dedicated multiplier units in the functional unit of a supercomputer. To meet the requirements of future applications the design of ultra supercomputer is essential. The ultra supercomputing speed may be required to forecast about natural calamities such as the earthquake, tsunami etc. Such applications needs to process huge matrix data from the sensors located at the remote place. Since, multiplication is the most time critical, most area and power consuming operation, the specialized design of multipliers for least delay, smallest in area and lowest in power consumptions are essential.

All the high speed parallel multiplication operation in hardware consists of three phases as follows.

1. Partial Product Generator (PPG).
2. Partial Product Reduction Tree (PPRT).
3. Carry Propagate Adder (CPA).

Since, the performance of the multipliers can be enhanced by designing high speed PPG circuits, many recent advanced paper [1]-[3] has been published. Since, the performance of the multipliers can also be enhanced to the most extent by designing high speed PPRT, many high performance papers [4]-[6] has been published. And finally since, the maximum speed of the multipliers depends on the performance of the

Carry Propagate Adder (CPA), various high speed CLA techniques have published in papers [7]-[10].

References [1]-[3] have presented the design of MBE architecture to generate a partial products in parallel. Reference [1] presented the design of PPG with 68 transistors in CMOS logic, and delay, area and power consumption measured has 0.033 ns/bit, $7.83 \mu\text{m}^2$ /bit and $1.81 \mu\text{W}$ /bit respectively. Reference [2] presented the design of PPG with 56 transistors in CMOS logic, and its delay, area and power consumption measured has 0.029 ns/bit, $0.13 \mu\text{m}^2$ /bit and $1.62 \mu\text{W}$ /bit respectively. Reference [3] presented the design of PPG with 56 transistors in CMOS logic, and its delay, area and power consumption measured has been 0.045 ns/bit, $0.12 \mu\text{m}^2$ /bit and $1.65 \mu\text{W}$ /bit respectively.

The second phase of the multiplier PPRT. Whose function is to reduce the n number of partial products to two only. Reference [4] presented the design of a PPRT using Three Dimensional Minimization (TDM) Method. The TDM has implemented with 98 transistors in CMOS logic, and its delay, area and power consumption measured has 0.06 ns, $30.87 \mu\text{m}^2$ and $26.43 \mu\text{W}$ respectively. Reference [1] has used the concept of reference [4] as PPRT.

Reference [5] presented the design of 4:2 and 5:2 compressors. The 4:2 compressor has implemented with 60 transistors in CMOS logic, and its delay, area and power consumption measured has 0.047 ns, $18.9 \mu\text{m}^2$ and $20.67 \mu\text{W}$ respectively. The 5:2 compressor takes 7-inputs and produces 4 outputs namely three carry and a sum. The 5:2 compressor has implemented with 90 transistors in CMOS logic, and its delay, area and power consumption measured has 0.06 ns, $28.35 \mu\text{m}^2$ and $24.3 \mu\text{W}$ respectively.

Reference [6] presented the design of Wallace tree for the addition of 7-bits of the PPRT, and the number of transistors, delay, area and power consumption has been same as the reference [6].

The final stage is the CPA, the fastest of all the CPA is the CLA. Reference [1] presented the design of multiple-level conditional-sum adder (MLCSMA) as the final stage adder for high speed operation. References [2]-[3] has been used the concept of references [7] - [10] presented the design of CPA for high speed, small area, and low power consumption.

II. PROPOSED 256x256 BITS MULTIPLIER

This multiplier is designed predicting the future 1 nm CMOS technology to the requirements of next generation ultra supercomputers. Fig. 1 shows the block diagram of super fast multiplier based on MMBE logic. Its operation is based on the concept of 4 to 1 multiplexer, and this is called as partial product generator (PPG). The MMBE produces all the partial products in parallel. Table I shows the truth table of proposed MMBE scheme. From table I equations (1) – (5) are obtained.

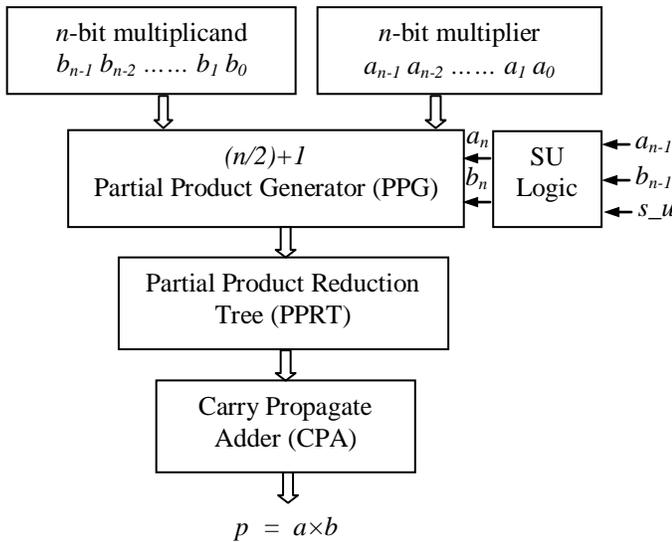


Fig. 1. Block diagram of proposed multiplier.

TABLE I
 TRUTH TABLE OF NMBE SCHEME

b_{i+1}	b_i	b_{i-1}	Operation	z_i	s_i	n_i
0	0	0	+0	0	0	0
0	0	1	+a	1	0	0
0	1	0	+a	1	0	0
0	1	1	+2a	0	1	0
1	0	0	-2a	0	1	1
1	0	1	-a	1	0	1
1	1	0	-a	1	0	1
1	1	1	-0	0	0	0

$$p_{ij} = x_{i+1} s_i + x_i z_i \tag{1}$$

$$s_i = b_i \oplus b_{i+1} \tag{2}$$

$$z_i = b_{i+1} \oplus b_{i-1} \tag{3}$$

$$x_{i+1} = b_{i+1} \oplus a_{i+1}, \quad x_i = b_{i+1} \oplus a_i \tag{4}$$

$$n_i = b_{i+1} (\overline{b_{i-1} b_i}) \tag{5}$$

Where the symbol ‘ \oplus ’ represents exclusive OR operation. For the Equations (1) to (4) MMBE logic diagram is as shown in Fig. 2. And using hybrid CMOS logic with 16 transistors is implemented as shown in Fig. 3. According to the input multiplier operand b , the MMBE logic selects $0, a, 2a, -a, -2a$ to generate the partial product rows in parallel. In equation (1) when $s_i = 1$, MMBE selects $-2a$ or $+2a$. And when $z_i = 1$, the MMBE selects $-a, +a$. The negate operation is achieved by one’s complementing each bit of a and then adding $n_i = 1$ to the least significant bit. The negate operation is implemented using equation (5).

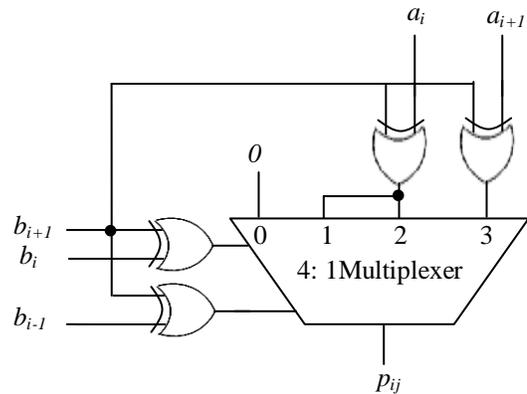


Fig. 2. Logic diagram of MMBE

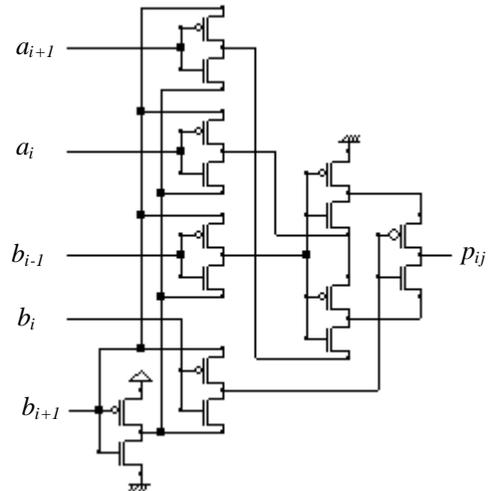


Fig. 3. Circuit diagram of MMBE

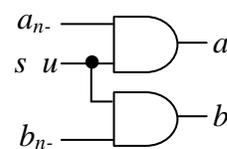


Fig. 4. Sign converter logic.

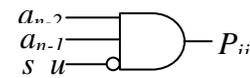


Fig. 5. Logic diagram for final bit of final row of PPG.

Fig. 4 shows the logic diagram of sign converter. A mode signal called signed-unsigned (s_u) is used to indicate whether the multiplication operation is for signed or unsigned number.

When

$s_u = 0$, indicates unsigned number multiplication.

$s_u = 1$, indicates signed number multiplication

For unsigned number multiplication, the requirement of 0 sign extended bit is as given in equation (6), and for the signed multiplication the sign extended bits required are given by the equations (7) and (8). Equation (9) generates a bit for signed-unsigned multiplication operation.

$$a_n = a_{n+1} = b_n = b_{n+1} = 0 \quad (6)$$

$$s_u = 1, a_{n-1} = 1, b_{n-1} = 0, a_n = a_{n+1} = 1, b_n = b_{n+1} = 0 \quad (7)$$

$$s_u = 1, a_{n-1} = 0, b_{n-1} = 1, a_n = a_{n+1} = 0, b_n = b_{n+1} = 1 \quad (8)$$

$$P_{ij} = \overline{s_u} a_{n-1} a_{n-2} \quad (9)$$

Where $i = n-1, j = n-1$.

Our proposed design of 256 bits multiplier is based on the prediction of the future 1 nm process technology. The various parameters required for the future process technology is explained as follows. For 1 nm process technology the delay of NMOS transistor is computed as follows.

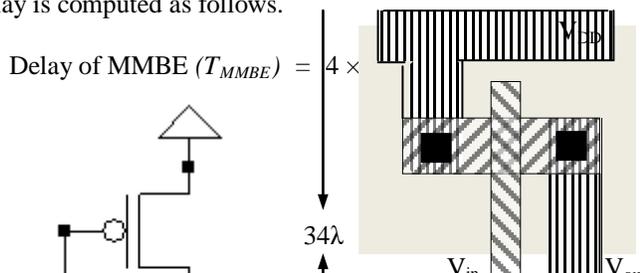
$$T_{dn} = \frac{L^2}{\mu_n V_{ds}}$$

Where L is the length of the channel and for 1 nm technology L is 1 nm, μ_n is the electron mobility carrier and its typical value at room temperature is $550 \text{ cm}^2 / \text{V sec}$, and for $V_{ds} = 1.8 \text{ V}$ supply voltage, $T_d = 0.01 \times 10^{-15} \text{ second} = 0.01 \text{ fs}$ (femto second).

For 1 nm process technology the delay of PMOS transistor is computed as follows.

$$T_{dp} = \frac{L^2}{\mu_p V_{ds}}$$

Where L is the length of the channel and for 1 nm technology L is 1 nm, μ_p is the hole mobility carrier and its typical value at room temperature is $240 \text{ cm}^2 / \text{V sec}$, and for $V_{ds} = 1.8 \text{ V}$ supply voltage, $T_d = 0.023 \times 10^{-15} \text{ second} = 0.023 \text{ fs}$ (femto second). But for the CMOS inverter shown in Fig. 6 when PMOS is turned ON, its resistance R_{ON} is about $4.5 \text{ K}\Omega$, then the switching speed of inverter reduces to 0.1 ps (pico second). The CMOS inverter delay measured by 45 nm technology has 0.006 ns , when CMOS technology decreases to 1 nm , then delay decreased to $0.006/25 = 0.24 \text{ ps}$. And thus the delay for the MMBE shown in Fig. 3 consists of 4 inverter delay is computed as follows.



For the layout of CMOS inverter shown in Fig, 7, area is computed as follows.

$$\text{Area} = 34\lambda \times 14\lambda$$

With $\lambda = 1 \text{ nm}$

$$\text{Area} = 34 \times 14\lambda = 476 \text{ nm}^2$$

The MMBE circuit of Fig. 3 uses 8 inverters, and the area is computed as follows..

$$\text{MMBE area } (A_{MMBE}) = 8 \times 476 \text{ nm}^2 = 3808 \text{ nm}^2$$

For 256 bits multiplier, there are 33280 MMBE's, thus the total area occupied by the MMBE is computed as follows.

$$\begin{aligned} \text{Total MMBE area } (A_{TMMBE}) &= 3808 \times 33280 \text{ nm}^2 \\ &= 126.73 \mu\text{m}^2 \end{aligned}$$

The power dissipated (P_d) by MMBE is computed as follows.

$$P_d = N F C V_{dd}^2$$

N = Number of transistor
 F = Frequency = 10 GHz
 Capacitance (C) = $0.0001 \times 10^{-15} \text{ F}$
 Power supply (V_{dd}) = 1.8 V

The power dissipated by the MMBE (P_{MMBE}) is computed as follows.

$$\begin{aligned} P_{MMBE} &= 258 \times 129 \times 10 \times 10 \times 10^9 \times 0.0001 \times 10^{-15} \times 1.8^2 \\ &= 1078.3 \mu\text{W} \end{aligned}$$

III. DESIGN OF VCA

Our proposed Vertical Column Adder (VCA) is based on the concept of references [4], [6] which presented the design of a PPRT with minimum delay. In this method, each column partial product bits of that column and carry bits generated by the previous column has been added to produce a sum bit and the number of carry bits. The carry bits from the previous column have been fed as input to the full adder so that the delay of the VCA has been the minimum. Fig. 8 (a) shows the circuit diagram of full adder, and is implemented in CMOS logic using only 10 transistors. Fig. 8(b) shows the circuit diagram of SCGP logic, this is the final cell of each VCA. Where cp_i is called carry propagate term, and cg_i is called carry generate term This is designed to perform operations such as sum, carry generate and carry propagate terms so as to save the extra hardware for carry generate and carry propagate terms and is implemented in CMOS logic using only 10 transistors.

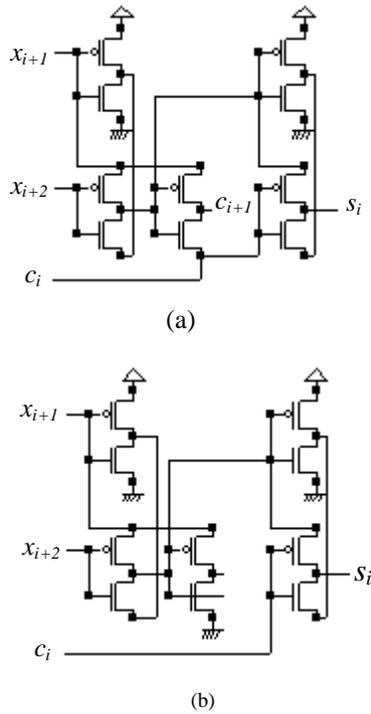


Fig. 8. Architecture of full adder. (a). Logic diagram. (b) Circuit diagram. (c) Circuit diagram of SCGP.

For 256 bits multiplier there are 256 VCA's, and VCS's are implemented using full adders. Each full adder is implemented using 5 inverters. Therefore, the delay and area are computed as follows/

$$PPRT \text{ delay } (T_{PPRT}) = 41.48 \times 10^{-12}$$

$$PPRT \text{ area} = 2496 \times 5 \times 476 \text{ nm}^2 = 5.92 \mu\text{m}^2$$

The power dissipated by the PPRT is computed as follows.

$$P_{PPRT} = 2496 \times 10 \times 10 \times 10^9 \times 0.0001 \times 10^{-15} \times 1.8^2 = 80.87 \mu\text{W}$$

Thus, the delay, area and power dissipated by the 256 bits multiplier is computed as follows.

IV. DESIGN OF CPA

The final adder which combines the effect of Carry Lookahead Adder and Carry Select Adder (CLCSA) is as shown in Fig. 11. The 8-bit CLA adder is designed and is used in cascade through carry select adder technique for high performance. All the 8-bit CLA adders produce carry in parallel and there are two such 8-bit CLA's in each stage with 0 and 1 as the initial carry input. If the final carry output from the previous stage of 8 bit CLA is 1 then the output selected by the 2:1 multiplexer is the output of the CLA adder with 1-input as the initial carry. Carry expressions for 8-bit CLA adder's are as follows.

$$c_1 = g_0 + p_0 c_{in}$$

$$c_2 = g_1 + p_1 g_0 + p_1 p_0 c_{in}$$

$$c_3 = g_2 + p_2 g_1 + p_2 p_1 g_0 + p_2 p_1 p_0 c_{in}$$

$$c_4 = g_3 + p_3 g_2 + p_3 p_2 g_1 + p_3 p_2 p_1 g_0 + p_3 p_2 p_1 p_0 c_{in}$$

$$c_5 = g_4 + p_4 g_3 + p_4 p_3 g_2 + p_4 p_3 p_2 g_1 + p_4 p_3 p_2 p_1 g_0 + p_4 p_3 p_2 p_1 p_0 c_{in}$$

$$c_6 = g_5 + p_5 g_4 + p_5 p_4 g_3 + p_5 p_4 p_3 g_2 + p_5 p_4 p_3 p_2 g_1 + p_5 p_4 p_3 p_2 p_1 g_0 + p_5 p_4 p_3 p_2 p_1 p_0 c_{in}$$

$$c_7 = g_6 + p_6 g_5 + p_6 p_5 g_4 + p_6 p_5 p_4 g_3 + p_6 p_5 p_4 p_3 g_2 + p_6 p_5 p_4 p_3 p_2 g_1 + p_6 p_5 p_4 p_3 p_2 p_1 g_0 + p_6 p_5 p_4 p_3 p_2 p_1 p_0 c_{in}$$

$$c_8 = g_7 + p_7 g_6 + p_7 p_6 g_5 + p_7 p_6 p_5 g_4 + p_7 p_6 p_5 p_4 g_3 + p_7 p_6 p_5 p_4 p_3 g_2 + p_7 p_6 p_5 p_4 p_3 p_2 g_1 + p_7 p_6 p_5 p_4 p_3 p_2 p_1 g_0 + p_7 p_6 p_5 p_4 p_3 p_2 p_1 p_0 c_{in}$$

Equations c_1 through c_8 are implemented as shown in Fig. 9. Inputs g_0 through g_7 has provided from the SCGP circuit of Fig. 9 (b). The inputs n_1 through n_8 are the outputs of nand gates, where n_1 is the output of 2-inputs nand gate, n_2 is the output of three inputs nand gate, and $n_3, n_4, n_5, n_6, n_7, n_8$ are outputs of 4, 5, 6, 7 and 8 inputs nand gates respectively. This has been implemented using only 94 transistors. The critical delay measured is 0.05ns.

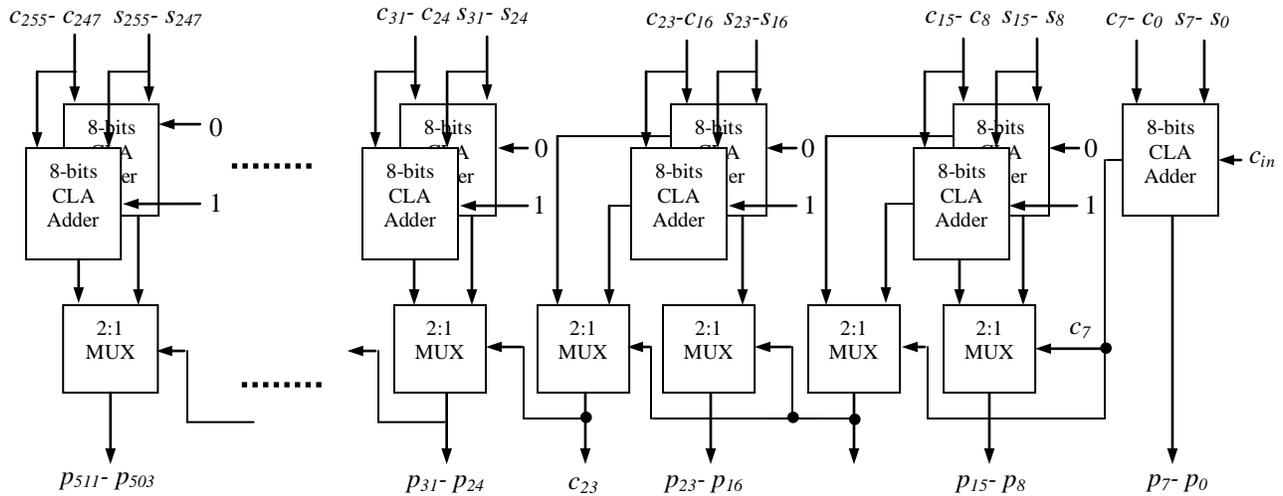


Fig. 9. Architecture of CLCSA for 256 bits multiplier.

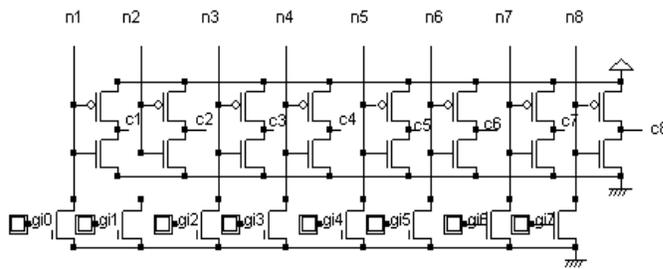


Fig. 10. Circuit diagram of 8-bit CLA carry

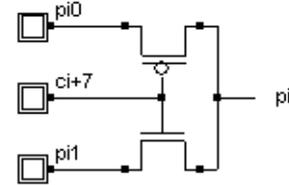


Fig. 11. Circuit diagram of 2:1

The delay of CLCSA is computed as follows.

$$T_{CLCSA} = 0.045 \text{ ns}/25 = 1.8 \text{ ps}$$

For 256 bits multiplier 32 CLCSA's are required, and its delay is computed as follows.

$$T_{CLCSA} = 0.045 \text{ ns}/25 = 32 \times 1.8 \text{ ps} = 57.6 \text{ ps}$$

The area for CLCSA is computed as follows.

$$8\text{-bits CLCSA area} = 59 \times 476 \text{ nm}^2 = 0.028 \mu\text{m}^2$$

For 256 bits multiplier 64 CLCSA's are required

$$\begin{aligned} 256 \text{ bits CLCSA area} &= 128 \times 0.028 \mu\text{m}^2 \\ &= 3.58 \mu\text{m}^2 \end{aligned}$$

The power dissipated by the CLCSA is computed as follows.

$$\begin{aligned} P_{dCLCSA} &= 64 \times 59 \times 10 \times 10^9 \times 0.0001 \times 10^{-15} \times 1.8^2 \\ &= 12.23 \mu\text{W} \end{aligned}$$

V. THEORETICAL RESULTS

The critical path delay of 256×256 Bits multipliers can be computed by using equation as follows.

$$\begin{aligned} \text{Delay } T_{256} &= T_{MMBE} + T_{PPRT} + T_{CLCSA} \\ &= 0.92 \times 10^{-12} + 41.48 \times 10^{-12} + 57.60 \times 10^{-12} \\ &= 0.1 \times 10^{-9} \text{ s} = 0.1 \text{ ns} \end{aligned}$$

$$\begin{aligned} \text{Area } A_{256} &= A_{MMBE} + A_{PPRT} + A_{CLCSA} \\ &= 126.73 \mu\text{m}^2 + 5.92 \mu\text{m}^2 + 3.58 \mu\text{m}^2 \\ &= 136.23 \mu\text{m}^2 \end{aligned}$$

$$\begin{aligned} \text{Power } P_{256} &= P_{MMBE} + P_{PPRT} + P_{CLCSA} \\ &= 1078.3 \mu\text{W} + 80.87 \mu\text{W} + 12.23 \mu\text{W} \\ &= 1171.4 \mu\text{W} \end{aligned}$$

These theoretical results listed in table I.

Table – 2 Comparison of multipliers

Multiplier Size	References	Delay (ns)	Area (μm^2)	Power (μW)
256x256	Reference [1]	0.21	11452.4	3806.0
	Reference [2]	0.23	10464.8	3206.0
	Reference [3]	0.24	9041.6	3007.7
	Proposed	0.10	136,23	1171.4

VI. CONCLUSION

Our proposed “Future Generation High Performance, Area Efficient And Low Power Multiplier Operating at 10 GHz”. With the future 1 nm Hybrid CMOS technology, the various parameters of the 256 × 256-Bit multiplier are the critical path delay of 0.1 ns, and with this delay it can operate with 10 GHz frequency, with chip area of 136.23 μm^2 and the power dissipation of 1171.4 μW . These results shows the better performance of our proposed multiplier.

ACKNOWLEDGEMENT

The authors would like to acknowledge the J S S Research foundation, SJCE Campus, Mysore, for all the facility provided for this research work.

REFERENCES

- [1] W. -C. Yeh and C. -W. Jen, “High Speed Booth encoded Parallel Multiplier Design,” IEEE transactions on computers, vol. 49, no. 7, pp. 692-701, July 2000.
- [2] Shiann-Rong Kuang, Jiun-Ping Wang, and Cang-Yuan Guo, “Modified Booth multipliers with a Regular Partial Product Array,” IEEE Transactions on circuits and systems-II, vol 56, No 5, May 2009.
- [3] Gensuke Goto, Atsuki Inoue, Ryoichi Ohe, Shoichiro Kashiwakura, Shin Mitarai, Takayuki Tsuru, and Tetsuo Izawa, “A 4.1 ns Compact 54x54-b Multiplier Utilising Sign-Select Booth Encoders”, IEEE journal of solid-state circuit, VOL. 32, NO. 11, November 1997.
- [4] Vogin G. Oklobdzija, David Vileger, Simon S. Liu, “A Method for Speed Optimized Partial Product Reduction and Generation of Fast Parallel Multipliers Using an Algorithmic Approach”, IEEE transaction on computers, Vol. 45, No. 3, pp. 294-306, March 1996.
- [5] C.-H. Chang, J. Gu, and M. Zhang, “Ultra low-voltage low-power CMOS 4-2 and 5-2 compressors for fast arithmetic circuits,” IEEE Trans.Circuits Syst. I, Reg. Papers, vol. 51, no. 10, pp. 1985-1997, Oct. 2004.

- [6] C. S. Wallace, “A Suggestion for a Fast Multiplier”, IEEE Transaction on Electronic Computers, pp. 14-17, February 1964.
- [7] Radu Zlatanovici, Sean Kao, and Borivoje Nikolic “A 240 ps 64 b carry-lookaheadadder in 90 nm CMOS,” IEEE journal of solid-state circuit., VOL. 44, NO. 2, pp.569-583, February 2009.
- [8] //: Analog and Digital Signal Processing., VOL. 43, NO. 10, OCTOBER 1996, pp.689-702.
- [9] T. P. Kelliher, R. M. Owens, M. J. Irwin, and T.-T. Hwang, “ELM-A Fast Addition Algorithm Discovered by a Program”, IEEE Trans. Comput, VOL. 41, NO. 9, September 1992, pp.1181-1184.
- [10] Amaury Nève, Helmut Schettler, Thomas Ludwig, Denis Flandre,,”Power-Delay Product Minimization in High-Performance 64-bit Carry Select Adders”, IEEE Trans. Very Large Scale Integr. Systems, VOL. 12, NO. 3, pp.235-244, MARCH 2004.



AUTHORS

First Author – Ravindra P Rajput received the BE degree in Electronics and Communication Engineering from Karnataka University Dharwad in 1996, M.Tech degree in Digital Electronics from Visvesvaraya Technological University, Belgaum in

2000. He is currently pursuing the PhD degree from Mysore University, Mysore. He is presently working as Associate Professor in the Department of Electronics and Communication, University BDT College of Engineering, Davanagere, Karnataka, India. He has published many books and papers in international conferences and Journals. His research interests include VLSI design, computer architecture, embedded systems, digital signal processing, Advanced microprocessors, design of high speed multipliers, Design of high speed adders.



Second Author – Dr. M. N. Shanmukha Swamy received the BE degree in Electronics and Communication Engineering from Mysore University in 1978, M.Tech degree in Industrial Electronics from the same University in 1987, and obtained his Ph.D. in the field of

Composite materials from Indian Institute of Science, Bangalore in 1997. He is presently working as Professor in the Department of Electronics and Communication, Sri Jayachamarajendra College of Engineering, Mysore, Karnataka, India. He is guiding several research scholars and has published many books and papers both in national and international conferences and Journals. His research area includes Wireless Sensor Networks, Biometrics, VLSI and composite materials for application in electronics.

Correspondence Author – Ravindra P Rajput, rprajput2006@gmail.com , 9886083949.

Synthesis and characterization of $Ba_{0.5}Sr_{0.5}(CO_{0.8}Fe_{0.2})_{1-x}Ti_xO_{3-\delta}$ (BSCF) Cathode for Solid Oxide Fuel Cell

D. Rama Krishna Sharma*, Dr P. Vijay Bhaskar Rao**

*Department of Physics, Visvesvaraya College of Engineering, Patelguda, Ibrahimpatnam, Hyderabad. India pin 501510

**Professor and Director R & D, St. Mary Engineering College, Deshmukhi (vill), Hyderabad

Abstract- The BSCF, Barium Strontium Cobalt Iron Titanate $\{Ba_{0.5}Sr_{0.5}(CO_{0.8}Fe_{0.2})_{1-x}Ti_xO_{3-\delta}\}$ [Where δ is the deficiency of oxygen & x is various compositions], powders have been synthesized by sol-Gel process using nitrate based powdered chemicals for SOFC applications as these powders are more useful for Cathodes and anodes for SOFCs since these powders are considered to be more promising cathode materials for SOFC. Ionic conduction, Adsorption and desorption rates are the major processes that control the electrode reactions. They contribute to the over potential. To obtain the low potential cathode materials suitable for the electrolytes, SOL-GEL method is used and nano powders are prepared. The Chelating agent used is Acetic acid, Ethylene glycol & Ammonia as dispersant. These powders were kept for calcinations at $900^{\circ}C$ for 16 hr and at $1100^{\circ}C$ for about 6 hr in crucibles of high alumina in furnace. These were characterized by XRD, SEM with EDAX, Densities, TGA and conductivities. XRD results proved the formation of Perovskite phase at all calcinations temperatures and the crystallite sizes were found to be 94.49nm, 103.9nm, 295.29 nm. From SEM, it is found that for some samples, there is presence of extreme porous particles present in nano sizes and conductivities, densities are studied

Index Terms- SEM/EDAX, TGA/DSC; XRD; Density; $Ba_{0.5}Sr_{0.5}(CO_{0.8}Fe_{0.2})_{1-x}Ti_xO_{3-\delta}$

I. INTRODUCTION

SOFCS (Solid oxide fuel cells) are one of the vital energy conversion devices with high oxygen vacancies. BSCF proved as good materials for solid cathode with appealing properties like ionic conductivity, super conductivity, Ferro electricity, magnetic resistance etc., Many cathodes were used in LSM, SSC, LSCF, BSCF, etc., but, the thermo-mechanical suitability between electrolyte and cathode can be improved by mixing cathode material with new element or a small impurity like Titanium. Such composite cathode will have a better ionic conductivity. As the cathode over potential is significant in SOFC's, it can be reduced by adding Titanium to BSCF. By increasing the percentage of Ti in site 'B' of ABO_3 (Perovskite structure), one can increase the efficiency and conductivity. Conventional SOFCs with an Ytria - Stabilized Zirconia (YSZ) cathode are not being operated at $900^{\circ}C$ or higher temperature operation causes serious problems such as internal mechanical stress due to the difference in the thermal expansion coefficients of the materials and chemical reactions. Therefore, operating temperature lower than $700^{\circ}C$ is desirable

[1]. because electrochemical and conduction processes in SOFC are strongly thermally activated, a reduced operating temperature leads to another difficulty in large voltage losses due to the ohmic resistance of the materials and polarization at the electrodes. Most of the voltage losses are generated from the ohmic resistance of the electrolyte, a number of approaches have been reported preparing a thinner electrolyte which reduces the corresponding resistance [2, 3], and high power density was obtained using YSZ thin film electrolytes [4, 5]. There are generally two categories making a robust anode-electrolyte-cathode cell while maintaining thin electrolyte layer: Cathode supported cell [6, 7] and

Anode supported cell [8-10]. Despite the fact that Cathode - supported cell can be produced by ceramic process (Toh) as well as by atmospheric plasma spraying (Siemens-Westing house) with scalable processes. Reducing the operating point temperature below $800^{\circ}C$ causes an increase of over potential at low temperature. Currently, La Sr Mn O (LSM) is commonly used as cathode material because of its high catalytic activity for oxygen reduction, thermal and chemical compatibility with Ytria stabilized new power generation system for their high - Zirconia (YSZ) [11, 12]. Recently strontium doped cobaltite has attracted much attention because of its mixed conduction characteristics and its relatively high ionic conductivity. Strontium doped samarium cobaltite (SmSrCoO: SSC) shows even higher conductivity, up to $10 S cm$ [13]. It shows good compatibility with ceria cathode. The cathodic reaction mechanism of SSC is not clearly understood. Ionic conduction, Adsorption and desorption rates are known as the major processes that control the electrode reactions. They contribute to the over potential. In practical the adsorption and desorption rates of SOFC are not equal. Therefore separate adsorption and desorption rates must be determined.

In the present paper, the objective is to prepare a cathode suitable for SOFC in single chamber fuel cell conditions. Hence, materials with a small percentage of Ti (with increasing values) are prepared and their characterization/values are compared.

Out of various fuel cells, solid-oxide fuel cells (SOFCs) have the benefit of eco friendly power generation with fuel [15] flexibility. High operating temperatures resulted in highly expensive, less compactness and low compatibility of cells. Hence, SOFCs [16] have been designed and developed and cathodes are prepared as they exhibit poor response for traditional and conventional cells, by using BSCF ($Ba Sr Co Fe$) newly, which exhibit high power densities i.e., $1,010 mW/cm^2$ and $402 mW/cm^2$ at $600^{\circ}C$ and $500^{\circ}C$. In this Hydrogen is used as fuel and air as cathode gas. BSCFs are suitable for single

chamber fuel cell operation. Hence, the alternative Perovskite Cathodes are chosen for high activity oxygen reduction.

These SOFCs will have high oxygen diffusivity. The important requirements for SOFC cathode materials are **i)**High electronic conductivity **ii)**Chemically suitable with electrolyte, **iii)**Stable in oxidation,**iv)** Large triple phase boundary, **v)**High ionic conductivity, **vi)**Suitable thermal expansion coefficient, **vii)**Simple fabrication and**viii)** Low cost. There are many materials which explain the reaction mechanisms of SOFC cathodes, like transport of oxygen, electrode kinetics, and involvement of chargeable particles in electrochemical processes. Reduction of oxygen at cathode is one of the important factors which contribute to the total resistance of the cell. Electro catalytic activity is also another important factor of SOFC.Hence by enhancing the porosity of cathode; one can increase the oxygen exchange and diffusion in cathode which results to higher current density in the cell.

Since six years **Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}**, **Ba_{0.5}Sr_{0.5}Co_{0.2}Fe_{0.8}** and other combinations have got much attention for intermediate temperature of SOFCs but, this reduction in temperature below 800°C causes an increase of the over potential of SOFC cathode. Therefore, to obtain the low potential cathode materials, the material **Ba_{0.5}Sr_{0.5}[Co_{0.8}Fe_{0.2}]_{1-x}Ti_xO_{3-δ}** is designed, { where 'x' is Various Compositions and 'δ' is deficiency of oxygen (0 or 0.1) }. By taking such doping of titanium with BSCF, the weight % was found to be 70%. Compared to SDC (Samaria- doped Ceria) this is 30% defective.

The structure is of ABO_{3-δ}, Perovskite. In this, oxygen ion vacancies will be pronounced along (B^{3+/4+})-O²⁻-(B^{3+/4+}), due to overlapping of the oxygen p-orbital and transition-metal d-orbital. When Ba is in site 'A', it increases the amount of B⁴⁺ ions and increases oxygen vacancies. In recent works, Itohet.al has shown the presence of both covalent and ionic bonds is BSCFO_{3-δ} and increases electron and oxygen ion conductivity at fairly low values of temperature. This clearly explains that the stoichiometry of oxygen decreases with increase in temperature and hence reduction in cations in site 'B' [17, 18]. SOFC performance will purely depend on sample preparation, its reactants, chemicals, stoichiometry, calcinations, sintering, acids, and bases. In recent papers, it is suggested that, by varying x and δ values in the BSCFO_{3-δ}[5582] would affect the performance. Hence, in the present study, investigation has been studied with **Ba_{0.5}Sr_{0.5}[Co_{0.8}Fe_{0.2}]_{1-x}Ti_xO_{3-δ}** by taking δ=0, δ=1 and x=0.10, 0.15, 0.20, 0.25 with different thermal properties. BSCF has proved as a good material for solid oxide fuel cell cathode [20,

21, and 22]. These have properties like ionic conductivity, Ferro electricity.

There are various models developed to explain reaction mechanisms off cathodes, of SOFCs[9, 10]. But, BSCF cathode preparation doped with Titanium and the over potential study is an important factor. A cathode should possess high electro catalytic activity for the reduction of oxygen. A good cathode should have high oxygen exchange and diffusivity so that, there will be rapid movement of oxygen ions [23]. This can also be obtained by increasing the porosity of BSCF cathode[24] which provide more dispersion of gases increasing reduction of oxygen. Hence, the current density will be generated within the cell.

II. EXPERIMENTAL

2.1 Materials:

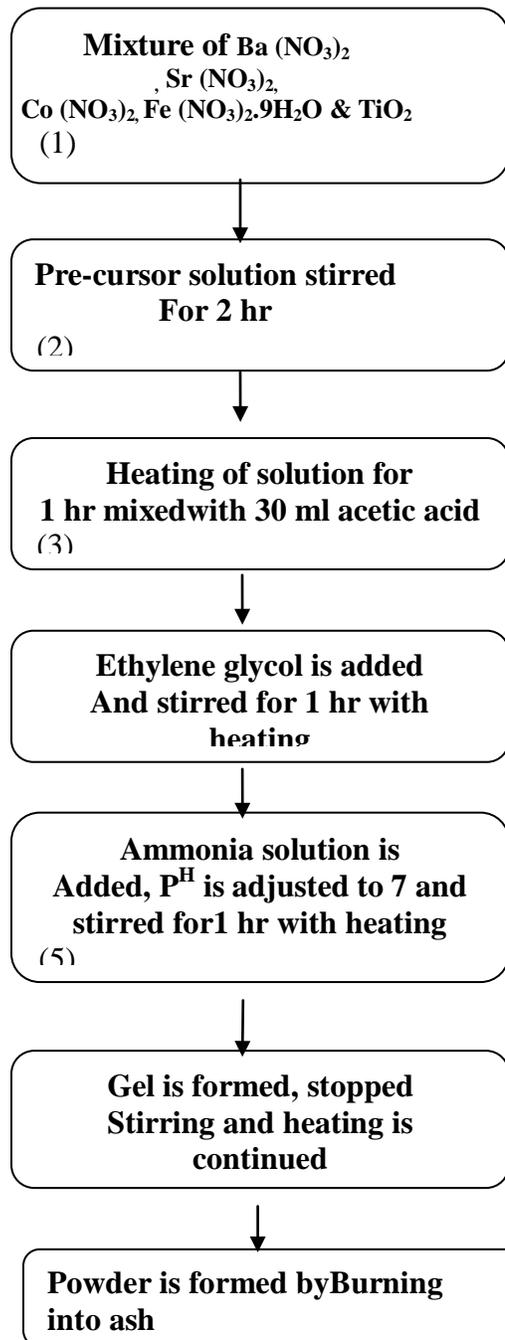
Commercial powders of AR grade of Aldrich Company were used in this work for the preparation of Cathode. Ethylene di-amine-tetra-acetic acid (EDTA), ethylene glycol, anhydrous citric acid, nitrate salts of Barium, Strontium, Cobalt, Iron and Zirconium oxide were purchased from Sigma Aldrich, USA. Ammoniasolution is used as base. In the present observations, the Nano crystalline cathode material of Ba_{0.5} Sr_{0.5} (Co_{0.8} Fe_{0.2})_{1-x} Ti_x O_{3-δ} by varying x values, (x = 0, 0.10, 0.15, 0.20) BSCF Ti(5582Ti) powders were prepared by sol-gel process as it is one of the economical ways and characterizations like SEM/ EDAX of LEO SUPRA 55 VD ultra high resolution of ZEISS , XRD TGA/DTA, Impedance Analyzer were used. Bariumnitrate Ba(NO₃)₂, StrontiumNitrate Sr(NO₃)₂ , Cobaltous Nitrate Co(NO₃)₂, Fluka Fe (NO₃)₂.9H₂O & TiO₂, are used.

2.2 Method

Precursor solution is prepared by taking above powders by appropriate formula and mixing ,aqueous solution of the above chemicals in molar ratio of 0.5:0.5 and 0.8:0.2 & required Acetic acid, ammonia, are added and $\frac{c}{n}$ ratio is maintained as 0.5. The solution is taken in borosil glass beaker and placed on a Magnetic stirrer with hot plate for about 4 hr with appropriate speed and by heating at about 80°C to 100°C , the solution is stirred till it becomes like a gel and then, the speed is reduced , heated for some time till it becomes ash after burning. The ash is calcined first at 750°C, for 8 hr, and at 900°C, for 8 hr and at 1050°C, 1100°C each for 2 hr and after preparing pellets, their densities are calculated as in table.1

Table. 1 Density calculations

Sam ple	Wt. in air (g)	Wt. in xylene (g)	$\rho_{Exp} = \frac{Wt.inair}{Lossofwt.inxylene}$	a (Lattice constant)	$\rho_{Th} = \frac{nM}{a^3 N_A}$	Density % = $\left\{ \frac{\rho_{Exp}}{\rho_{Th}} \right\} * 100$
Ti ₁	0.2376	0.1943	5.5169	4.0016 Å	5.6419	97%
Ti ₂	0.3773	0.3108	5.4120	3.9793 Å	5.7727	95%
Ti ₃	0.3866	0.3167	5.5198	3.9804 Å	5.6051	97%
Ti ₄	0.3183	0.2594	5.4179	3.9873 Å	5.6620	96%



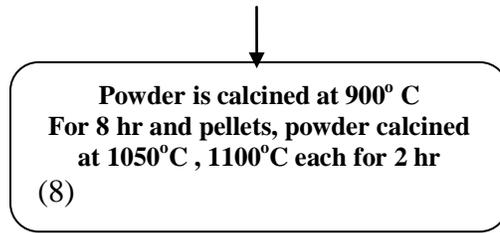


Figure 1. Flow chart of method of preparation of sample

III. CHARACTERIZATION

3.1 XRD Characterization:

X-ray diffraction (XRD) analysis of the sintered samples is carried out with XRD at 40 KV and 30mA, using CuK α radiation with diffraction angle (2θ) range from 20° to 80° and particle size is determined by line broadening technique as shown below for all four samples. It is clear that, powder is partially amorphous and it is observed that calcined powders were of Perovskite structure and these were found to be similar with other XRD's of various authors. It is observed that, at higher temperatures, the noise in XRD is reduced and still it can be reduced by calcining the samples at about 1100 °C , 1150 °C or more.

Table 2.Cathode (BSCFTi – 5582Ti)powders by sol-gel process.

Sample	Cathode powder	c/n
Ti ₁	Ba_{0.5}Sr_{0.5}[Co_{0.8}Fe_{0.2}]_{0.9}Ti_{0.1}O₂	0.5
Ti ₂	Ba_{0.5}Sr_{0.5}[Co_{0.8}Fe_{0.2}]_{0.85}Ti_{0.15}O₂	0.5

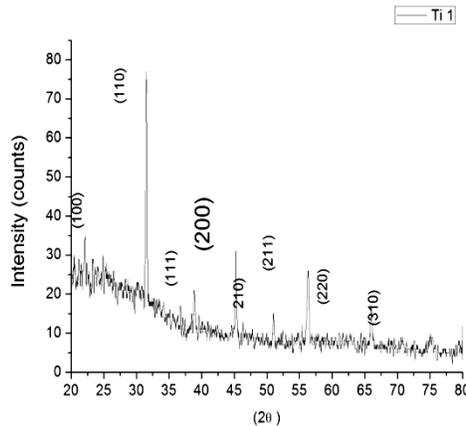


Figure.2 XRD Patterns of Ba_{0.5} Sr_{0.5} (Co_{0.8} Fe_{0.2})_{L-x} Ti_xO_{3-δ} with δ=0, x=0.1 calcined at1050° C

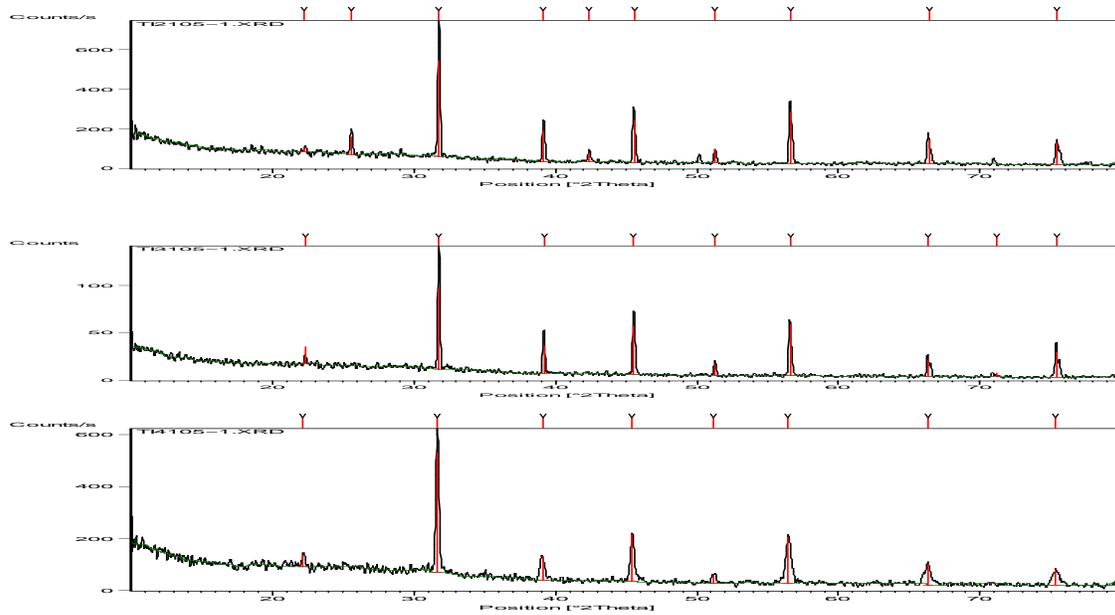


Figure3. XRDs of Ti₁, Ti₂, Ti₃ samples

Table. 3XRD data for determining the average particle size of BSCF Ti (5582 Ti)

Sample	2θ	θ	Cos θ	FMHM (β)	Particle size $D = \frac{0.9\lambda}{\beta \cos\theta}$ nm
Ti ₁	31.571	15.786	0.96228	0.4723	30.506
Ti ₂	31.7698	15.8849	0.9618	0.3149	45.77
Ti ₃	31.6666	15.8333	0.9620	0.4723	30.51

Where $\lambda = 1.540510$ nm

3.2 SEM with EDAX Characterization:

Few amounts of powders and pellets were used for study of compounds present in the samples after calcinations using ZEISS Scanning Electron microscope and images of various magnifications were done. The sem photographs of Ti₁ & Ti₂ samples are as under.

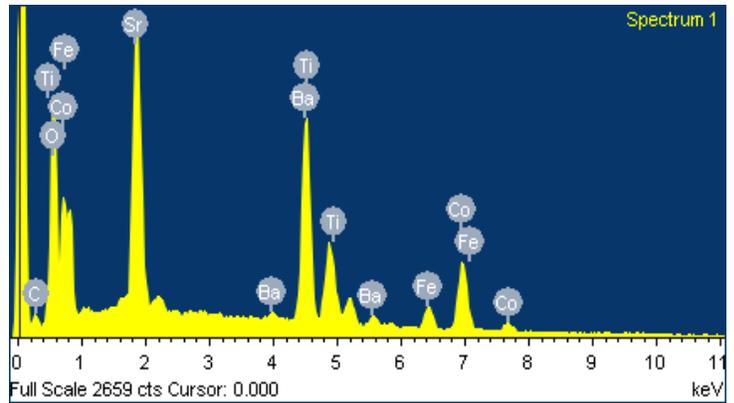
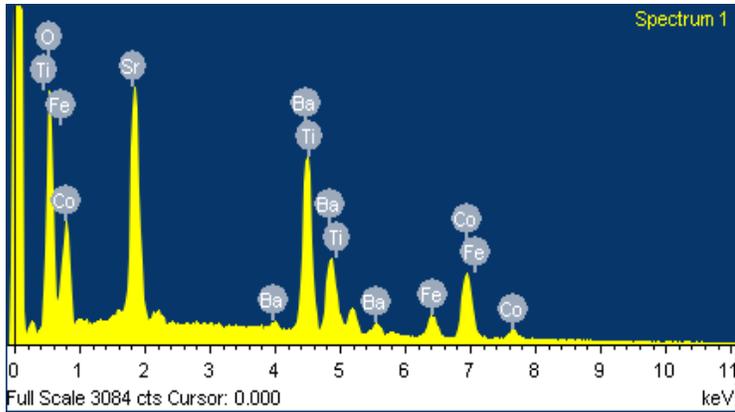


Figure.3 (a) SEM with EDAX of Ti1 sample

Figure. 3(b) SEM with EDAX of Ti 2 sample

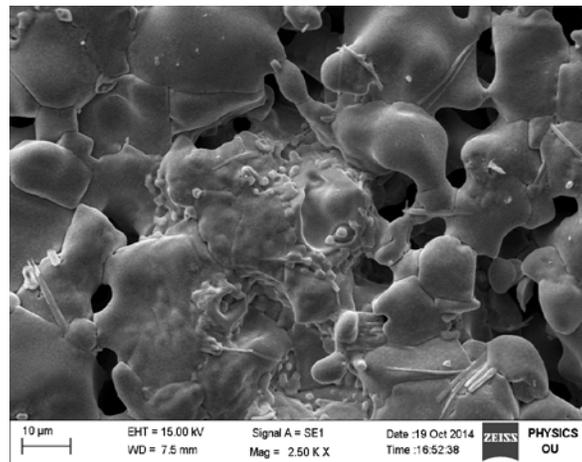
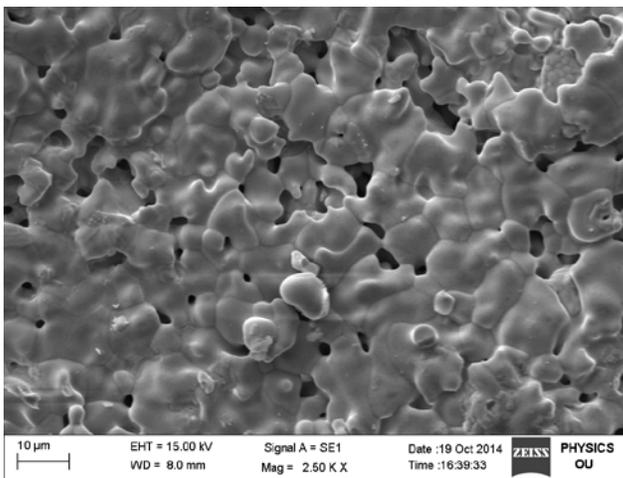


Figure .4(a) SEM Photograph of sample 1

Figure. 4(b) SEM Photograph of sample 2

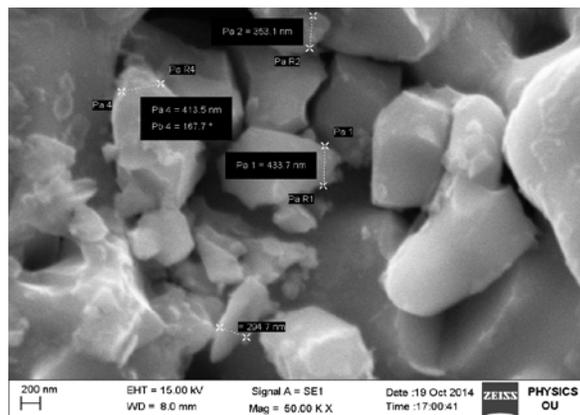
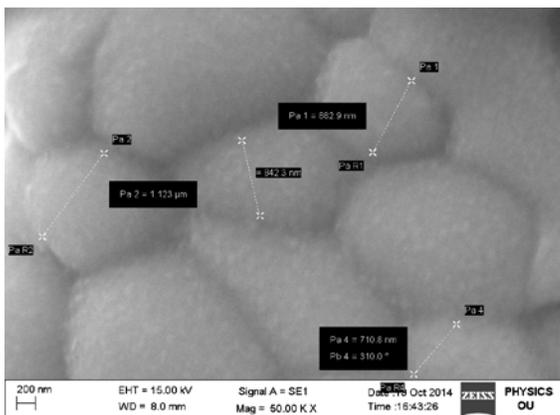


Figure.5 (a) SEM of sample 1, particle size

Figure. 5(c) SEM of sample 2, particle size

From SEM with EDAX analysis, it is found that the atomic percentage as taken in the formula is not changed and all atoms are present in the same proportion, particle sizes are noted which are in good coincidence with the data taken from XRD. The figures show the presence of Ba, Sr, Co, Fe, Ti, C peaks. The appearance of C may be due to usage of acetic acid. This C % has been reduced by calcining the samples at a higher temperature.

IV. TGA/DTA CHARACTERIZATION

The curves in figures 6(a) and 6(b) correspond to TGA (weight loss in % Vs temperature) and DTA(Rate of losing weight Vs temperature) for Ti_1 and Ti_2 samples. DTA is studied with difference in temperature and flow of heat between the sample and a reference. Moisture, Thermal stability and composition are studied simultaneously by TG/DTA referring Exothermic and Endothermic processes.

Powder samples of Ti_1 of 10.6 mg and Ti_2 of 7.6 mg are taken and corresponding curves are recorded. The weight loss is observed for three times in TGA first at $78^\circ C$ due to evaporation of moisture , second at $490^\circ C$ due to evaporation of nitrates and third at $640^\circ C$ due to evaporation of other impurities because of usage of acids,bases etc,.. The melting point can be at about $1070^\circ C$ or $1100^\circ C$.

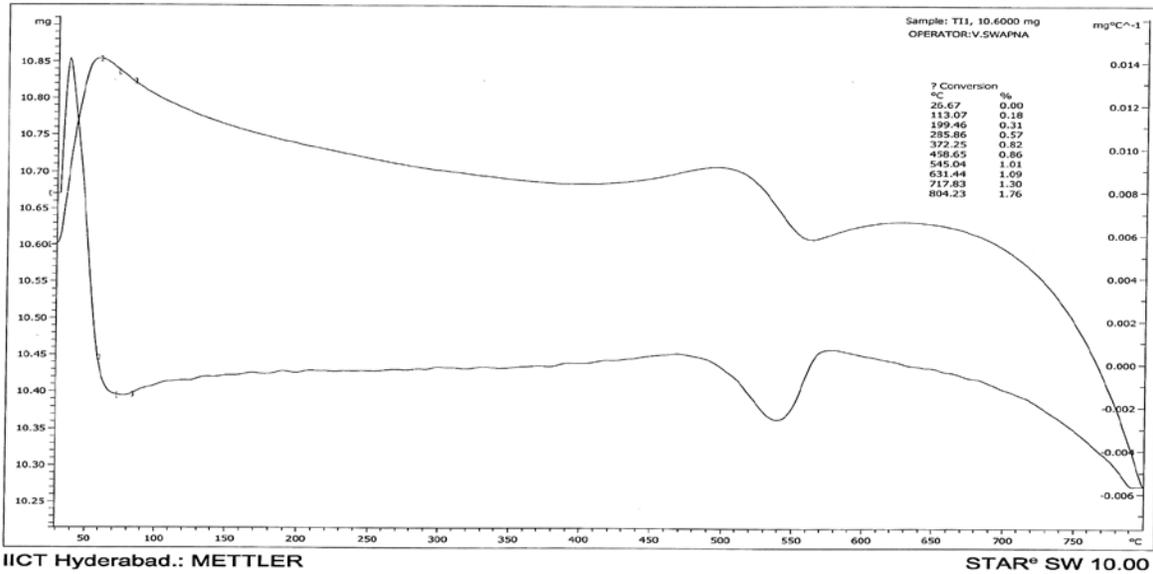


Figure. 6(a) TGA/DTA Curves for $Ba_{0.5}Sr_{0.5}[Co_{0.8}Fe_{0.2}]_{0.9}Ti_{0.1}O_2$

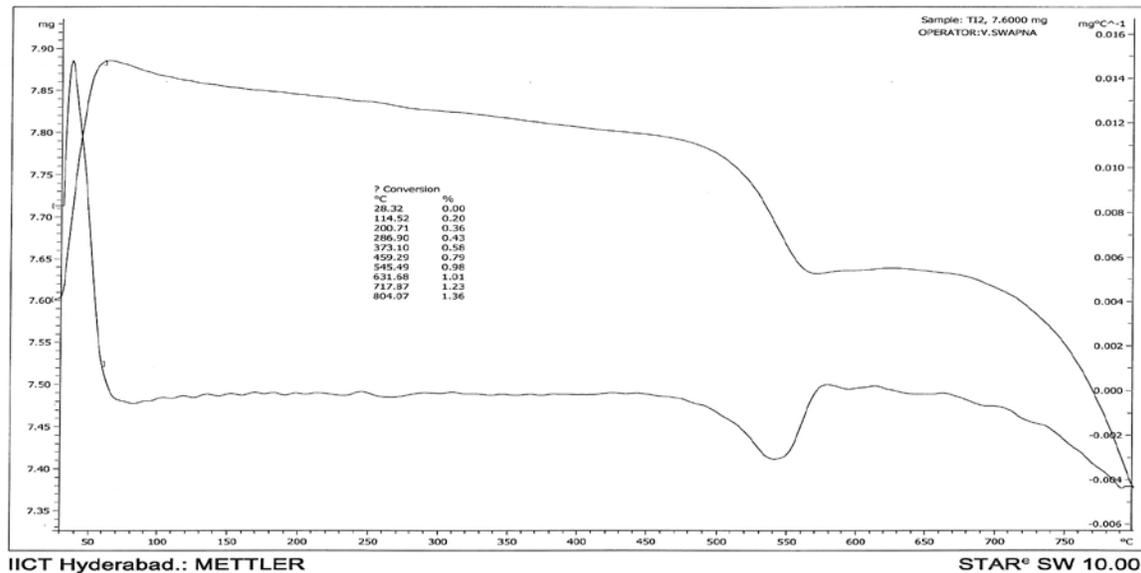


Fig. 6(b) TGA/DTA Curves for $Ba_{0.5}Sr_{0.5}[Co_{0.8}Fe_{0.2}]_{0.85}Ti_{0.15}O_2$

V. IMPEDANCE ANALYSIS

To characterize the electrochemical properties of BSCFTi cathode, AC impedance values are measured and characterization of cathode processes is based on the application of ac potential

$E(t) = E_o \cos(\omega t + \phi)$ of minimum amplitude such that ac current $I(t) = I_o \cos(\omega t - \phi)$ is obtained.

$$\frac{E(t)}{I(t)}$$

Impedance, $Z = \frac{E(t)}{I(t)}$ is calculated at different AC frequencies up to few MHz

The impedance measurements characterizes the physical and chemical processes related to time constants ,electron transfer at high frequencies and mass transfer at low frequencies. In the present study, the impedance measurements were carried from room temperature to 150⁰ C and Nyquist plots ($Z_s = Z_{Real} + Z_{Imaginary}$) are drawn as shown in figures 7(a) for Ti₁ sample and 8(a) for Ti₂ sample respectively.

The cole-cole plots are observed for Z^I and Z^{II} plots as depicted in figures 7(a) & 8(a) .

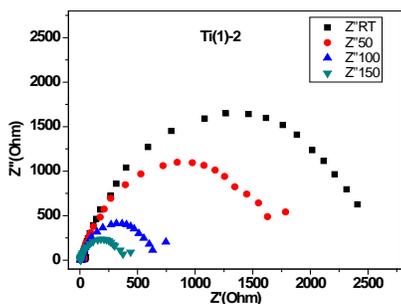


Figure .7(a) COLE-COLE plot of Ti sample

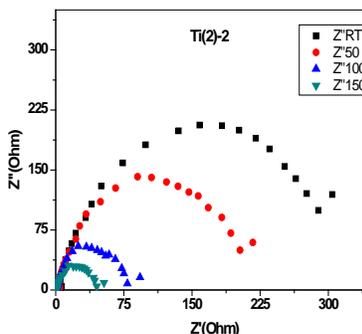


Figure .8(a) COLE-COLE plot of Ti2 sample

The stable behavior of the real part of the impedance with frequency is observed with increase of temperature as shown in figures 7(b) & 8(b).

From cole-cole plots one can calculate the grain resistance (R_g) and grain boundary (R_{gb}) resistance and their temperature dependence can be observed.

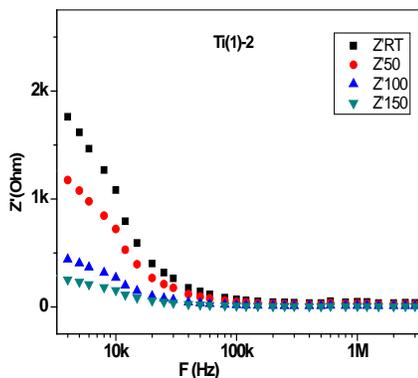


Figure.7 (b) Z Vs Frequency curves

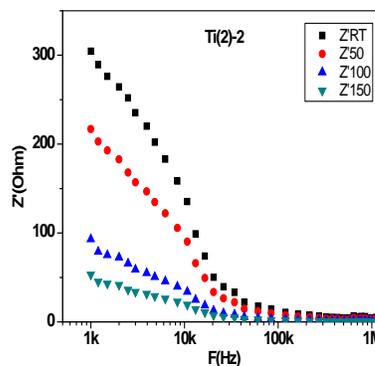


Figure.8 (b) Z Vs Frequency curves

It is observed from figures 7 (c) and 8(c) that, the peak frequencies were shifted for imaginary component of Z^{II} Vs Frequency as temperature increases. This is the relaxed behavior of a sample.

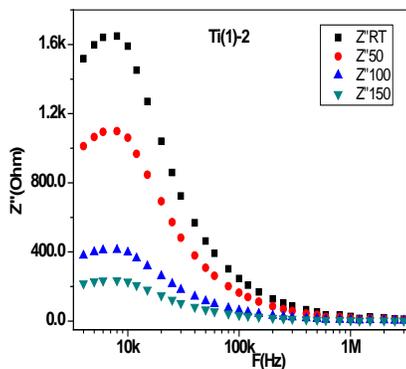


Figure.7(c) Z Vs Frequency curves

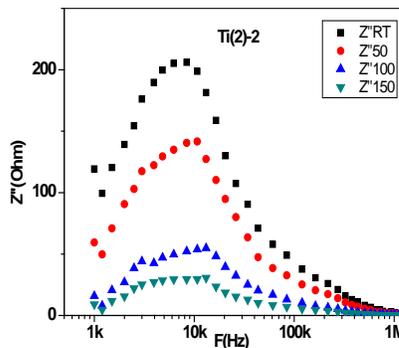


Figure.8(c) Z Vs Frequency curves

AC conductivity is calculated by the formula $\sigma_{AC}^l = \frac{Y^l t}{A}$ where Y^l is called admittance, t is thickness of the sample and A is area of the sample. The conductivities are tabulated in tables 4 & 5 below.

Table 4. Calculation of conductivities through AC Impedance of Ti 1 Sample:

S.No	Temperature	Resistance (ohm)	Admittance (Y)	Area(A) m ²	Thickness(t) m	$\sigma_{AC}^l = \frac{Y^l t}{A}$
1	Room temp.	1750	5.714×10^{-4}	69.42×10^{-6}	1.46×10^{-3}	0.0120
2	50	1200	8.33×10^{-4}	69.42×10^{-6}	1.46×10^{-3}	0.01752
3	100	500	2×10^{-3}	69.42×10^{-6}	1.46×10^{-3}	0.042059
4	150	250	4×10^{-3}	69.42×10^{-6}	1.46×10^{-3}	0.08411

Table 5. Calculation of conductivities through AC Impedance of Ti 2 Sample:

S.No	Temperature	Resistance	Admittance	Area(A) m ²	Thickness(t) m	$\sigma_{AC}^l = \frac{Y^l t}{A}$
1	Room temp.	320	3.125×10^{-3}	70.6124×10^{-6}	1.42×10^{-3}	0.06284
2	50	230	4.347×10^{-3}	70.6124×10^{-6}	1.42×10^{-3}	0.087417
3	100	95	0.01052	70.6124×10^{-6}	1.42×10^{-3}	0.211556
4	150	50	0.02	70.6124×10^{-6}	1.42×10^{-3}	0.402197

VI. RESULTS AND DISCUSSIONS

- In this study, the composition of the material was adjusted in such a way that the dopant will take its place on site B of Perovskite structure ABO_3 .
- The X-Ray diffraction patterns of powdered BSCFTi were studied at different temperatures starting from 750 °C but diffraction peaks were found to be broad and very weak and sample was not crystallized perfectly. But, as the sintering temperature is increased, the impurity peaks due to Fe_3O_4 Co. The sharp lines in XRD pattern depicts a well crystallized structure is formed. All the peaks indicate a Perovskite structure and correspond to planes (100), (110), (111), (200), (210), (211), (220), (300), (221), (310). There are some other peaks are also observed due to impurities and these were also disappeared as the

doping of Ti is increased and sintering is done for much time accordingly. The particle sizes of samples are calculated using XRD data.

- Densities of samples are calculated and for all samples the density percentage is above 90% .
- SEM images of BSCFTi proved the presence of porous spherical particles of nano size for the powders calcined above 850°C.
- From TGA plots it can be concluded that there is no weight loss after about 540°C which indicates that combustion process is completed at this temperature and oxide phases are formed.
- As the concentration of Ti increases the resistance of the sample has been decreased and conductivity increased.
- AC conductivities of all samples are calculated and observed that, as temperature is increased, resistance is decreased and conductivity is increased and the graph

between ac conductivity (along y-axis) and $1000/T$ along x-axis will be a linear graph.

ACKNOWLEDGEMENTS

Authors thank Chairman, R&D team of St. Mary's Engineering College, Department of Physics - Osmania University, and Department of physics-JNTU Hyderabad, Chairman, Secretary, Principal & Department of Physics-Visvesvaraya College of Engineering and Technology, Hyderabad, Telangana State, INDIA.

REFERENCES

- [1] T. Ishihara, H. Matsuda, Y. Takita, J. Am. Chem. Soc. 116(1994) 3801
- [2] K. Huang, M. Feng, J.B. Goodenough, J. Electrochem. Soc.
- [3] J.P.P. Huijismans, F.P.F. Berkel, G.M. Christie, J. Power
- [4] R. Maric, S. Ohara, T. Fukui, H. Yoshida, M. Nishimura, T. Vol. PV 94-12, Electrochemistry Society, 1994, Inagaki, K. Miura, J. Electrochem. Soc. 146 2006
- [5] P. Huang, A. Horke, A. Petric, J. Am. Ceram. Soc. 82 (1999) Electrochem. Soc. 134 (1978) 21412402
- [6] F. Chen, M. Liu, J. Solid State Electrochem. 3 (1998) 7. Tuller (Eds) Proceeding 1st International Symposium Ionic
- [7] T. Ishihara, H. Matsuda, Y. Takita, in: Proceedings 2nd Ionic and Mixed Conducting Ceramics, Electrochemistry Society, and Mixed Conducting Ceramics, Vol PV 94-12, Electro- 1991, p. 122. Chemistry Society, 1994, p. 85.
- [8] T. Ishihara, M. Honda, Y. Takita, Recent Res. Dev. Electrochem 2 (1999) 15
- [9] N.Q. Minh, T. Takahashi, in: Science and Technology of Nishiguchi, Y. Takita, J. Electrochem. Soc. 145 (1999) 3177. Ceramic Fuel Cell, 1995, p. 147.
- [10] S. Majumdar, T. Claar, B. Flandermeyer, J. Am. Ceram. Soc. 144 (1997) 3620. 69
- [11] O. Yamamoto, Y. Takeda, R. Kanno, H.U. Anderson, Solid State Ionics 22 (1989)
- [12] A. Hammouche, E. Siebert, A. Hammou, Mater. Res. Bull. 24 (1989) 367.
- [13] T. Ishihara, M. Honda, T. Shibayama, H. Minami, H. Nishiguchi, Y. Takita,
- [14] J. A. Kilner, R.A. De Souza, I. C. Fullerton, Solid state Ionics P. SSC 86-88 (1996) 703. O2
- [15] A Boudghene Stambouli and E, Traversa, Renewable and Suitable Energy Rev., 6.433 (2002)
- [16] S. J. Skinner, Int. T. Inorganic Matter., 3, 113 (2001)
- [17] Z. Shao and S. M. Haile, Nature (London) 431, 432, 170 (2004)
- [18] Y. Itoh, V. Nishida, A. Tomita, Y. Fujie. Solid state communication. 149. 41 (2008)
- [19] B. Liu, Y. Zhang and L. Tang, Int. J. Hydrogen Energy, 34, 435 (2009)
- [20] X. Sun, S. Li, J. Sun, X. Liu, B. Zhu, Int. J. Electrochem. Sci. (2007) 462
- [21] A. Subrahmanya, T. Saradha, S. Muzumathi, J. Power Sources 165 (2007) 728
- [22] H. Zhao, F. Mauvy, C. Lalanne, J.M. Bassat, S. Fourcade, J.C Grenier, Solid State Ionics 179 (2008) 2000
- [23] A. Princivalle, E. D. Jurado, SSI 179 (2008) 1921
- [24] V. B. Vert, J.M. Serra, Fuel Cells (2009) 663
- [25] Y. Li, R. Gemmen, X. Liu, J. Power sources, 195 (2010) 3345 [26] S.S. Shimizu, T. Yamaguchi, Y. Fujishiro, ECS Tans. 25 (2009) 975

AUTHORS

First Author – D.Rama Krishna Sharma, Department of physics, Visvesvaraya college of Engineering, Patelguda, Ibrahimpatnam, Hyderabad. India pin 501510, Email: dhulipalarks@gmail.com, vcethyd@yahoo.com

Second Author – Dr P. Vijay Bhaskar Rao, Professor and Director R & D, St. Mary Engineering College, Deshmukhi (vill), HYDERABAD.

AUTOMATIC PAY AND PARK SYSTEM

Sushil Palande, Surekha Gangurde, Akshay Pote

Electronics and Telecommunication Department
P.E.S. Modern College of Engineering Pune-05

ABSTRACT- This paper is about creating a reliable system that takes over the task of identifying free slots in a parking area and keeping the record of vehicles parked very accurately. This project lessens the human effort at the parking area to great extent such as in case of searching of free slot by the driver and calculating payment for each vehicle using the parking area. This system employs ATmega 644 as its heart which comes under AVR family of microcontrollers. The various steps involved in this operation are vehicle identification, free slot detection and payment calculation. Vehicle identification is carried out using RFID and here it is suggested that each vehicle to have unique identity. Free slot detection is carried out using display. Payment calculation is done on the basis of period of parking and this is done with the help of real time clock (RTC). For the system to be more reliable, RTC is powered from a separate dc source.

INDEX TERMS- RFID, GSM, Atmega644, Automation.

I. INTRODUCTION

RFID today is the popular wireless induction system. Each RFID tag in RFID system is given a unique ID (UID). When an independent RFID tag approaches the RFID reader, the induction between tag and reader happens. The information and content recorded in the tag is transmitted to the RFID reader and translated into the computational data. Following up the data translation, the tag recognition can be completed and related applications are provided. The RFID card is used to identify that a user is legal or not. According to the short- distance wireless signal, the RFID tag users can be monitored within the specific area. However, most of these applications are based on the indoor environments or be a tiny area service. In opposition to creating new execution or service environment, there were many existing systems or applications deployed. This project aims at implementing an Automatic Pay and Parking System using RFID.

The second stage is reading the data from the RFID tag to the RFID reader. In the third stage, the data is updated from RFID reader to the Database. The final stage is to keep a track of vacancies of the parking spaces. In this paper, a realistic application Automatic Pay and Parking System is proposed. Via using the proposed system, the main contributions are:

The project is implemented in four stages:

Step 1: Writing into the tag:

By making use of the write capability of the RFID reader, RFID tag is embedded with unique identification code and is assigned to a car. This is similar to embedding information on a magnetic strip and the process is called writing. The tag contains distinct information about the car, like employee ID number or name or

any other distinct data. This step accomplishes the data feed to the tag.

Step 2: Reading from the tag:

The information from the tag needs to be read during the car parking. In this step, the data is read from the tag with the help of an RFID reader.

Step 3: Data feed to the System:

The data from the RFID reader has to be transferred to the system for the actual comparison of data and further processes. During this phase the data from the RFID reader is fed to the system using RS232.

Step 4: Tracking the count:

To properly utilize the parking lot, the number of the cars presented in the parking lot needs to be tracked. In this the number of cars in the parking lot is incremented for every car entering the lot and is decremented for every car leaving the lot.

2. RFID SYSTEM

The RFID System consists of a reader, and RFID tags. Each RFID tag records a unique ID and finite information. The tag is triggered when it approaches the RFID reader. The information recorded in the tag is transmitted to the RFID reader.

A RFID reader will pass the signal into the digital and computing content. In the proposed *RFID* Parking system the RFID reader is deployed at the gate. In addition, the RFID tags are placed in the car. Considering the practicability, the *RFID System* should overcome the accuracy affection of weather and sunshade-paster of car, and the RFID tag type. When an Automatic Pay and Parking System user's car approaches the gate, the induction and communication between RFID tag inside the car and antenna of RFID System is automatically established. Then the reader of RFID System translates the signal information to the digital content. Fig.1 presents the work flowchart of the RFID System. The same procedure will be followed whenever the vehicle leaves from a parking slot. The user again has to swipe the card while coming out of the parking lot [4].

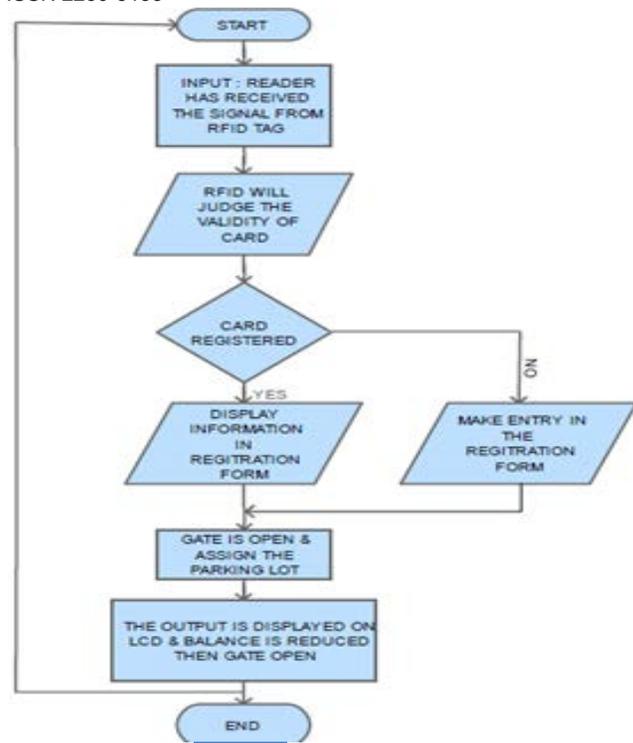


Fig. 1: The work flowchart of RFID System

2. WORKFLOW

2.1 Parking Lot Monitoring Module

The flow diagram of vehicle detection module is shown in the figure 2. The parking lot is provided with infrared sensors and is allowed to sense the parking area continuously 24x7. If it detects any vehicle in the parking lot, it will indicate the presence of vehicle to the microcontroller to which it is interfaced.

The microcontroller will in turn send the status information to database system. Continuous update will take place as the system works continuously for 24x7. A display device is provided at the entrance of the parking bay which helps the users to identify whether the parking lot is available or not. This scenario suits well for single level parking system.

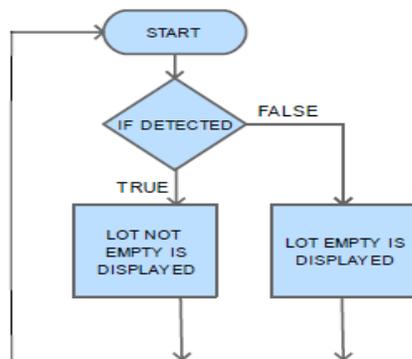


Figure 2: Vehicle Detection Flow Chart.

2.2. Parking Lot Reservation Module

The flow diagram of parking lot reservation module is shown in the figure 3. When the user wants to reserve a parking lot in advance, user has to send a reservation SMS. When the coordinator system receives the SMS from the user, it will start

to check whether there is any vacancy in the parking lot. If lot ~~756~~ available means the control unit will send an acknowledgement message to the respective user who has requested for parking lot reservation. A timer will be started for that reservation. Before the timer expires the user has to reach, if not means the reservation will get expired and the expiration message will be sent to the user. If lot is not available means lot not available SMS will be sent to the user. If user reaches on time means, he has to access the parking lot. The barrier gate will get open and allow the user to enter the parking level. Once the user parked the vehicle in the respective parking lot allotted, the user has to press a key, which is available in the parking lot which enables the security monitoring of the vehicle.

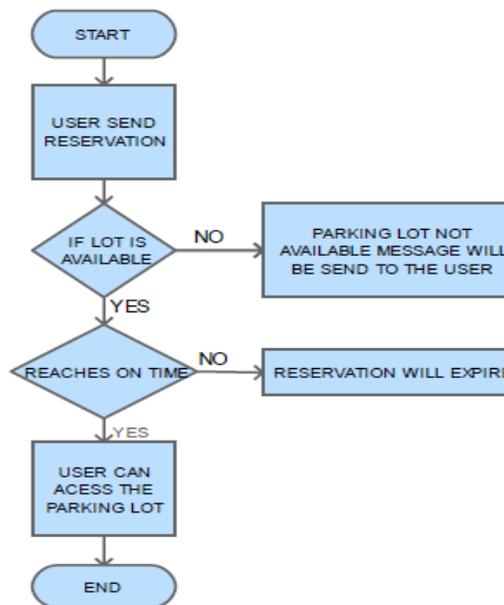


Figure 3: Reservation Flow Chart.

3. DESIGN OVERVIEW

The Automatic Pay and Park system includes access control unit (normally a PC), Atmega 644 series microcontroller, Rf module, keypad, barrier gate, and display unit. As mentioned earlier this system has three modules; parking lot monitoring module, lot reservation module, and security module. Each parking lot will be provided with infrared sensor, whose function is to monitor the parking field 24x7.

The infrared sensors are interfaced with the Atmega644 microcontroller. The lot status is continuously transmitted to the coordinator system where the database is maintained. A barrier gate is provided to each level of parking bay. Each level may have number of parking lots. UART communication is carried out between GSM and the microcontroller. Dot Net framework is used to construct the access system.

3.1. RFID

The EM18 RFID Module. Using the board with controller to read a card's data is very simple and requires just a serial connection. The board has on board poser indication LED, this indicate the presence of a RFID card. All the io pins are brought out labeled header pins.

3.2. ATMEGA644 Microcontroller

The ATmega644 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. The On chip ISP Flash allows the program memory to be reprogrammed in-system through an SPI serial interface. The Atmel ATmega644 is powerful microcontroller that provides a highly-flexible and cost-effective solution to many embedded control applications.

3.3. GSM

GSM (Global System for Mobile communication) is a wireless communication device used to receive the user's request for reserving the parking lot and also for sending the entry and exit password to the user for accessing the parking lot. SIM300 V7.3 version modem is used in this system. AT command sets were used to access the GSM modem [3]. GSM modem is interfaced with the coordinator system using RS-232 COM connection.

3.4. LCD

LCD is a display device interfaced with the microcontroller which is placed at the parking level. The LCD is used to display the value entered by the user.

4. RESULTS AND EXPERIMENTS

Experiments were conducted and it proves to be very successful. The screenshots of the front end access system and the prototype of the parking lot management system are shown in the figure below.

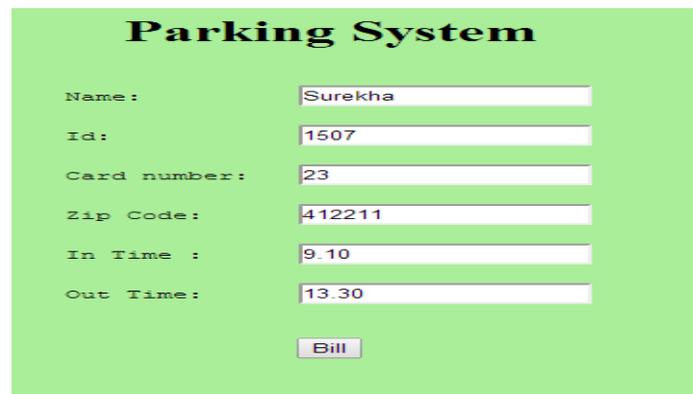


Figure 5: Access Form.

The figure 5 shows the front end access form with number of fields. The front end access system is constructed using VB.Net. It consists of number of user friendly fields which can be easily accessed by the users. Figure 6 shows the reception of the users request for lot reservation.

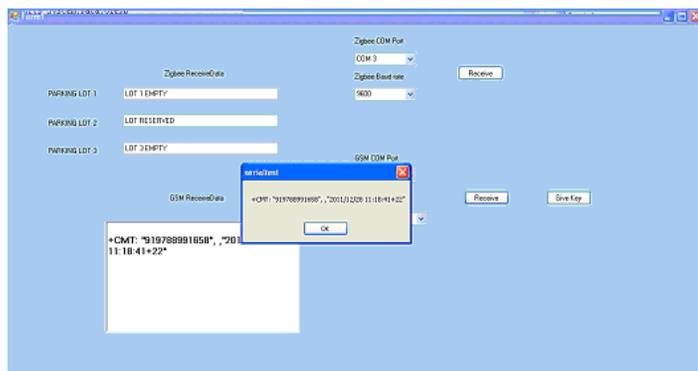


Figure 6: Access Form of User's Message Validation. 757

Figure 7 shows the prototype of the lot monitoring and management system for single level vehicle parking system.



Figure 7: Prototype of Parking Lot Monitoring System.

The coordinator setup which consist of front end system to which controller end node and GSM modem are interfaced.

SIM 900 type modem is used in this system. AT commands for sms will vary according to the manufacturers. The controller circuit diagram of the lot monitoring module. It includes LCD, MAX232, ATMEGA 644 controller, four infrared sensor modules and a D type 9-pin connector.

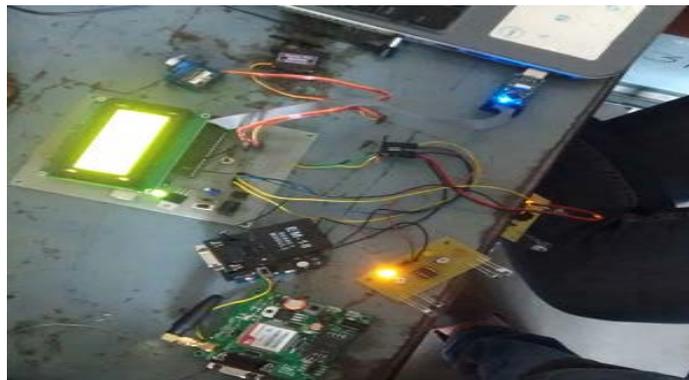


Figure 8: whole System

On the whole, this system provides security to the parked vehicle, reduces the unnecessary time taken for finding the empty space in parking area, and also reduces the traffic and unnecessary mess inside the parking area.

5. CONCLUSION

This system holds good for Automatic parking system, as it provides higher level of security for the vehicles parked in the respective parking spots. This system also reduces the traffic and congestion in finding the available parking spots. The security of the vehicle and the experimentation result proves that the system provides higher level security for the parked vehicles and is easily implementable in real time. This system holds a working rate of 9.5 out of 10. On the whole this system proves to be cost effective and highly secure.

ACKNOWLEDGEMENT

Author wish to acknowledge P.E.S. Modern college of Engineering Pune, for the time and support.

REFERENCES

[1] Moscow Metro Tries RFID-Enabled Ticketing, RFID Journal, February 2007,
<http://www.rfidjournal.com/article/view/3049/>

[2] Noor Hazrin Hany Mohamad Hanif, Mohd Hafiz Badiozaman, Hanita Daud. "Smart Parking Reservation System Using Short Message Services.

[3] GSM AT command set © UbiNetics 2001, Application Note AN010.

[4] "RFID Field Guide - Deploying Radio Frequency Identification System" by Manish Bhuptani, Shahram Moradpour, Sun Microsystems Press, A Prentice Hall Title, Myrna Rivera, USA, Feb 2005.

[5] "Auto Theft Statistics". @ <http://www.autotheft.info/Statistics.htm>. © 2002 Auto- Theft.info.

758

[6] Chumkamon.S, Tuvaphanthaphiphat.p, Keeratiwintakorn.p. "The vertical handoff between GSM and ZIGBEE networks for vehicular communication. ©2010 IEEE conferences.

First Author: Mr. Sushil Palande [B.E.]
P.E.S. Modern College of Engineering, Pune-05.
Email: palandesushil5006@gmail.com
Second Author: Mrs. Surekha Shivram Gangurde [B.E.]
P.E.S. Modern College of Engineering, Pune-05.
Email: ranigangurde@gmail.com
Third Author: Mr. Akshay Pote [B.E.]
P.E.S. Modern College of Engineering, Pune-05.
Email: a.pote1990@gmail.com
College Guide: Mrs. R. S. Chaudhari

P.E.S. Modern College of Engineering, Pune-05.

Email: rupali.chaudhari06@gmail.com

Estimation of Caffeine in different brands of Energy drinks by Ultra-Violet Spectroscopy

Muhammad Mufakkar*, Kalsoom Fatima*, Huma Faheem*, Shakeel Ahmad** and Muhammad Hammad Khan***

*Department of Chemistry, Government College of Science, Wahdat Road Lahore, Pakistan.

**Department of Chemistry, Government M.A.O. College, Lower Mall Lahore, Pakistan.

***Centre for Environment protection studies, PCSIR laboratories, Ferozpur Road Lahore, Pakistan.

Abstract- Some drink manufacturers do not report how much Caffeine is present in their products. This work was done for the estimation of caffeine in ten different brands of energy drinks available in the market with the help of Ultra-Violet spectroscopy. These result showed that the concentration of Caffeine is much higher than in the different brands of soft drinks. The highest concentration of Caffeine was found in Power Horse (0.754955 mg/mL), so it is strongest CNS (central nervous system) stimulant among all other analyzed energy drinks. The lowest concentration of Caffeine among investigated energy drinks was Big Apple (0.100901 mg/mL). So it is the weakest stimulant among all samples.

Index Terms- Caffeine, Ultra-Violet spectroscopy, energy drinks, central nervous system, drug.

I. INTRODUCTION

Caffeine is a drug and shares a number of traits with more notorious drugs such as Cocaine and Heroin. It uses the same bio-chemical mechanisms as those other drugs to stimulate brain functions [1]. Its molecular formula is $C_8H_{10}N_4O_2$ and called trimethylxanthine [2]. According to the Huckel rule it is aromatic in nature [3]. Caffeine occurs naturally in many plants such as Coffee beans, Tea leaves and Cocoa beans [4]. It is moderately soluble in water at room temperature and its solubility increases with temperature [5]. It is weakly basic ($pK_a \sim 0.6$) [6]. It has a number of effects: improves performance during sleep deprivation, in shift workers it leads to fewer mistakes caused by tiredness, moderate doses in athletics can improve spirit, endurance or tolerance and team sports performance [7-11]. A high dose of caffeine has adverse effect on health [12-14]. The amount of Caffeine needed to produce effects varies from person to person, depending on body size and degree of tolerance. However the regular users develop a strong tolerance to these effects [15]. Energy drinks have large concentrations of Caffeine with sugar and other stimulants. These are the new trend in caffeinated beverages [16]. However some drink manufacturers do not report how much Caffeine is present in their products [17].

II. MATERIAL AND METHOD

The different brands of energy drinks were got from local market. The Caffeine content of the different energy drinks was calculated by UV spectrophotometer 3000.

A. Preparation of standard and sample solution:

a. Standard stock solution preparation

The standard stock solution of Caffeine was prepared by weighing 0.02 gram of Caffeine and was dissolved in 1000 mL of distilled water. After preparing the stock solution the dilutions were prepared as:

5 mL, 10 mL, 15 mL, 20 mL, 25 mL, 30 mL, 35 mL, 40 mL, 45 mL, 50 mL, 55 mL, 60 mL and 65 mL of stock solution were taken in 100 mL measuring flask separately and were diluted with distilled water up to the mark. In this way thirteen dilutions were made having concentrations of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2 and 1.3 mg per mL of the solutions respectively.

Sample solution preparation

First of all each energy drink solution was warmed to decarbonated them. Then 1 mL of each energy drink sample was diluted up to 100 mL with distilled water and took the absorbance at 272 nm. The absorbencies of these different solutions were shown in Table 2.

B. Determination of Wavelength [λ_{max}]

The λ_{max} was determined by scanning the standard solution from 190-400 nm range. We got the maximum absorbance [λ_{max}] at 272 nm. This value was used for calculating the absorbencies of different dilutions. The absorbencies of different dilutions are given in Table 1. Using the data obtained from UV spectrophotometer for the different dilutions of standard stock solution, a calibration curve got by plotting absorbance versus concentration of dilutions. The calibration curve is shown in Fig.1.

III. RESULT AND DISCUSSION

The absorbance of different brands of energy drinks was measured at 272 nm and by applying the formula we determined the concentration of Caffeine in them. Their results were shown in Table 2 and in figure 2. The concentration of Caffeine in Big Apple, Panda, Vimto, Red Bull Extra, Power Full, Red Bull, Mad Croc, Baar, Booster and Power Horse were found to be 0.100901, 0.136937, 0.272072, 0.400000, 0.454054, 0.455856, 0.475676, 0.554955, 0.61982 and 0.754955 mg/mL. It was concluded from the above data that the highest concentration of Caffeine was found in Power Horse, so it is a strongest CNS stimulant. The lowest concentration among the analyzed energy drinks was found in Big Apple.

REFERENCES

- [1] Muhammad Mufakkar, Muhammad Hammad Khan, Shakeel Ahmad, Faisal Ali, Tahir Mahmood; Estimation of Caffeine in different brands of soft drinks by Ultraviolet Spectroscopy, IJSRP, 2014, vol.4, issue 8, ISSN 2250-3153.
- [2] S. Bolton, G. Null; Caffeine, psychological effects, use and abuse Orthomolecular Psychiatry; 1981, 10(3): 202-211.
- [3] Ashihara H, Moonteiro AM, Gillies FM, Crozier A; Biosynthesis of Caffeine in Leaves of Coffee. Plant Physiol. 1996, 111(3): 747-753.
- [4] R. Matissek; European Food Research and Tecnology, 1997, 205(3): 175-84.
- [5] Susan Budavari; The Merck Index, Whitehouse Station, NJ: Merck & Co., Inc. 1996, Ed. 12th P. 1674.
- [6] L. Klosterman; The facts about Caffeine (drugs). Benchmark Books (NY). 2006, P.43. ISBN 0-7614-2242-0.
- [7] J. Snel , M.M. Lorist ; Effects of Caffeine on sleep and cognition. Prog. Brain Res. Progress in Brain Research, 2011, 190: 105-107.
- [8] K. Ker, P.J. Edwards, L.M. Felix, K. Blackhall, I. Roberts; Caffeine for the prevention of injuries and errors in shifts workers. In Ker, Katharine. Cochrane Database Syst. Rev. 2010, (5) CD 008508.
- [9] D. Bishop; Dietary supplements and team sport performance. Sports Med. 2010, 40 (12): 995-1017.
- [10] S.A. Conger, G.L. Warren, M.A. Hardy, M.L. Millard-Stafford; Does Caffeine added to carbohydrate provide additional ergogenic benefit for endurance? Int. j. Sport Nutr. Exerc. Metrab. 2011, 21 (1): 71-84.
- [11] T.A. Astorino, D.W. Roberson; Efficacy of acute caffeine ingestion for short-term high intensity exercise performance: a systematic review. J. Strength Cond. Res.2010, 24 (1): 257-265.
- [12] M.E.M. Angelucci, C. Cesario , R.H. Hiroi, P.L. Rosalen, C. Da Cunha, Brazilian journal of medical and biological research, 2003, 35(10) 1201-1208.
- [13] K. Keenan Emma, Tiplady Brain, M. Priestley Caroline, J. Rogers Peter, Journal of caffeine research, 2014, 4(1): 13-20.
- [14] A. Verkhatsky, Physiol. Rev.' 2005, 85(1): 201-79.
- [15] Kapil Kalara, Sumit Kumar, Jyoti Maithani, International Journal of Pharmacy and life sciences, 2011,(2) 11:1214-1215.
- [16] Meier, Barry; Energy Drinks promise edge but experts say proof is scant, The New York Times, ISSN 0362-4331, Retrieved 26 September 2014.
- [17] Consumer Reports (December 2012), Energy Drinks-Caffeine levels, Consumer reports org. Retrieved 26 September 2014.

AUTHORS

First Author – Muhammad Mufakkar, Department of Chemistry, Government College of Science, Wahdat Road Lahore, Pakistan.
Second Author – Kalsoom Fatima, Department of Chemistry, Government College of Science, Wahdat Road Lahore, Pakistan.
Third Author – Huma Faheem, Department of Chemistry, Government College of Science, Wahdat Road Lahore, Pakistan.
Fourth Author – Shakeel Ahmad, Department of Chemistry, Government M.A.O. College, Lower Mall Lahore, Pakistan.
Fifth Author – Muhammad Hammad Khan, Centre for Environment protection studies, PCSIR laboratories, Ferozepur Road Lahore, Pakistan.

Figures and Tables

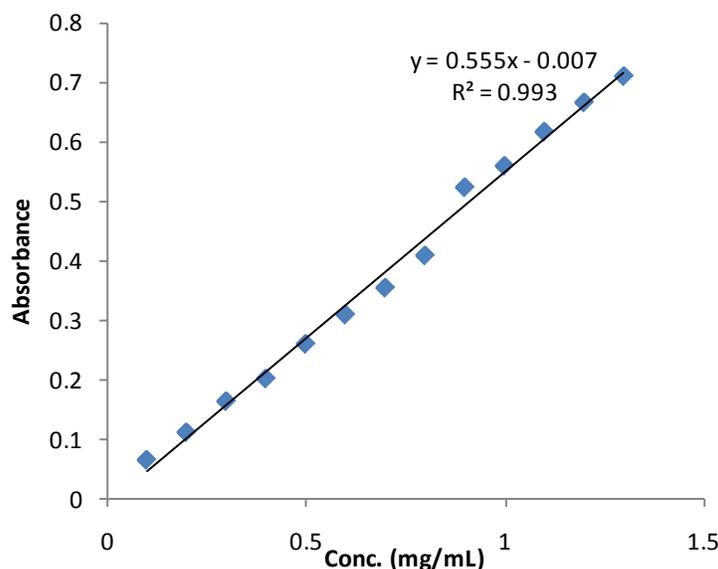


Figure1: Absorbance versus concentration of caffeine standards. ■ - Absorbance, -- trend line

Table 1. Absorbencies of dilutions

Sr. No.	Dilutions (mg/mL)	Absorbance
1	0.1	0.067
2	0.2	0.113

3	0.3	0.165
4	0.4	0.203
5	0.5	0.261
6	0.6	0.310
7	0.7	0.355
8	0.8	0.409
9	0.9	0.523
10	1.0	0.559
11	1.1	0.616
12	1.2	0.665
13	1.3	0.709

Table 2. Caffeine in drinks

different brands of energy

Sr.No.	Energy drink	Absorbance	Concentrations (mg/mL)
1	Big Apple	0.049	0.100901
2	Panda	0.069	0.136937
3	Vimto	0.144	0.272072
4	Red Bull Extra	0.215	0.400000
5	Power Full	0.245	0.454054
6	Red Bull	0.246	0.455856
7	Mad Croc	0.257	0.475676
8	Baar	0.301	0.554955
9	Booster	0.337	0.61982
10	Power Horse	0.412	0.754955

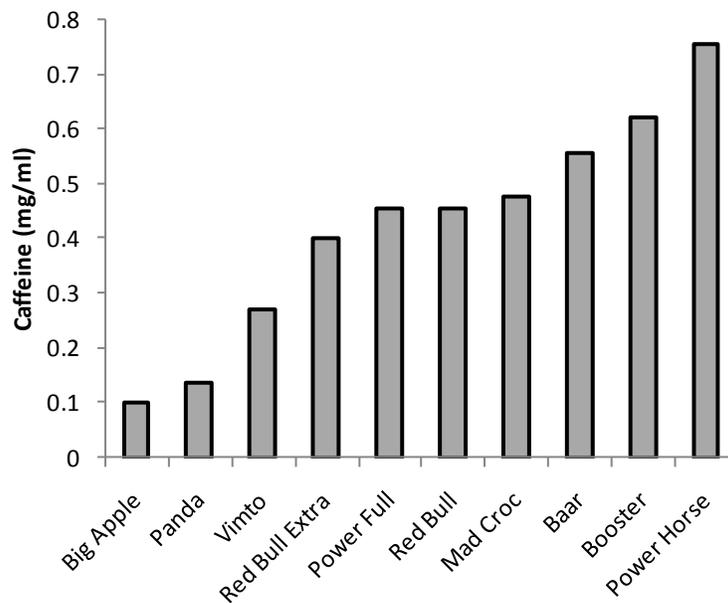


Figure 2: Caffeine in different energy drinks.

Nature of the Dogra State and the condition of the Muslims of Kashmir (1846 – 1930)

Showkat Ahmad Wani

Research Scholar, Centre of Advanced Study, Deptt. of History, Aligarh Muslim, University. U.P. India

I. INTRODUCTION

The worst feature of the Dogra rule was its communal outlook. It discriminated the Muslims on the basis of their religion and also interfered in their religious affairs. The Dogra State was actually a Hindu State and its rulers tried their best to broaden its Hindu nature, with the result Kashmiri Pandits as a co-religionists' class found it easy to get associated with it and the Muslims were marginalised.¹ Regarding the nature of the Dogra Government, P. N. Bazaz, declared in 1941: "Speaking generally and from the bourgeois point of view, the Dogra rule has been a Hindu Raj. Muslims have not been treated fairly, by which I mean as fairly as the Hindus. Firstly, because, contrary to all professions of treating all classes equally, it must be candidly admitted that Muslims were dealt with harshly in certain respects only because they were Muslims."² It is reported that Gulab Singh in 1850, made a plan to reconvert the Muslims, but, the Banaras priests did not accept it, as according to them it would dilute the purity of Hinduism.³ In fact, in 1846, he made it clear that he would not allow Muslims to practise all their religious practices and that as a Hindu; he would have to give priority to the religion of Hindus.⁴ The British for the good of 'ensuring the sway of *Pax-Britannica*,' tolerated it.⁵ Colonel Torrens, who visited Kashmir (1859-60) during the reign of Ranbir Singh, records that the Dogra rule was the Hindu 'rule' which was run by 'Hindu' *faqueers*, detested by people, they prey upon, but supported and encouraged by the Government. In order to prove it a Hindu State it invaded Muslim places and erected temples.⁶ A large number of Muslim shrines and mosques were confiscated and declared State property, like Pather Masjid, Khanqah Sokhta, Khanqah Bulbulshah, Khanqah Darashikoh, Idgah and so on in

Srinagar and Khanqah Sufi Shah and Bahu Mosque in Jammu.⁷ In order to check the spread of Islam, a law was promulgated by the Government by which if a Hindu converted to Islam, he was debarred from the right of inheritance and in case of vice versa, he could attain the right of inheritance.⁸ Besides they (who would convert to Islam) were subjected to various difficulties and inconveniences by local officials.⁹ For a small minority, the majority was not allowed to slaughter cow, ox etc. Cow killing was banned and those found guilty were severely punished. First the punishment was death sentence but later on it was reduced to life imprisonment¹⁰ and then 7 years of imprisonment.¹¹ It is necessary here to mention that there were frequent famines in Kashmir and scarcity of food and they had no alternative but to slaughter their own cattle, but it was not allowed.¹² In the second decade of twentieth century, there were 117 prisoners in Kashmir, out of which 99 were Muslims, being punished for killing cows.¹³ Maharaja Ranbir Singh banned the catching of fish because of the belief that the late maharaja's soul had

¹ Mridu Rai, *Hindu Rulers Muslim Subjects, Islam, Rights, and the History of Kashmir*, Delhi, 2004 p. 80.

² Bazaz, *Inside Kashmir*, Srinagar, 2002 (edition), p. 250.

³ J. Korbel, *Danger In Kashmir*, Srinagar, (1954), repr. 2008, p.13.

⁴ For further details see M Rai, op. cit., pp. 86 and 93.

⁵ M Rai, op. cit., p 84.

⁶ For example Tukht-i- Suliman was invaded there was erected a temple, Lt. Col. Torrens, *Travels Through Ladakh, Tartary and Kashmir*, p. 300. Cited in Saraf, pp. 259-60

⁷ *Glancy Commission Report*, p. 3. These were converted into granaries and ammunition centres. Malik Fazal Hussain, *Kashmir Aur Dogra Raj 1848-1931* (Urdu), Srinagar, (1931), p.153.

⁸ M. F. Hussain, *Freedom Struggle In Kashmir*, New Delhi, 2002, p. 153.

⁹ Report of the (Glancy) Commission, Appointed Under the Orders of His Highness the Maharaja Bahadur dated the 12th November, 1931, To Enquire Into Grievances and Complaints, Rambir Government Press, Jammu, 1932, p. 5.

¹⁰ R. Thorpe, *Kashmir Misgovernment*, (ed) S. N. Gadru, *Kashmir Papers*, Srinagar, 1973. pp.79-80 pp. 77-78.

¹¹ Tyndale Biscoe, *Kashmir In Sunlight and Shade*, 2006, Srinagar, p.119. Its influence was mostly felt in city and the villagers continued to eat beef, though secretly that is why in Srinagar even today the people do not take beef.

¹² Knight, *Where Three Empires Meet*, London, 1893, p. 115.

¹³ Tyndale Biscoe, *An Autobiography*, (Srinagar, 2003), p. 188.

transmitted into the body of a fish.¹⁴ Ranbir Singh also closed the Friday market in Jama Masjid, Srinagar and opened a new market called Maharaja Gunj.¹⁵ Even the Muslim names were not tolerated and many Muslim names were changed into Hindu names; like Islamabad into Anatnag, Takt-i-Sulimani into Shankaracharya.¹⁶ After ascending the throne in 1885,

Pratap Singh assured that no discrimination would be made between his subjects.¹⁷ But he could not fulfil his promise and came under the influence of Hindu religion and all his functions which were participated by military and civil officials, had religious tinge.¹⁸ In fact, he would say, "Do not give too much to Rajputs, use Kashmiri Pandits as much as you can and see that the Muslims do not starve."¹⁹ He would not tolerate to see the face of a Muslim (till noon) and the shade of a Muslim over the water, which was brought from Cheshma Shahi Srinagar for him, and the guilty was punished and imprisoned.²⁰ Maharaja Hari Singh discouraged the business of Muslims and Muslim contractors. Instead of encouraging local contractors, the Maharaja encouraged the high contractors from outside and gave them loans without any interest.

II. ADMINISTRATION

The Dogra rulers in order to have a class loyal to the State filled the State administration with the Punjabis and Dogras and also Kashmiri Pandits but not Kashmiri Muslims.²¹ Though the Muslims constituted the majority of the State population and the major tax payers of the State but they were not considered fit for the State business²² and very few (Muslims) were employed on high positions.²³ In 1930 in the bureaucracy, Hindus and Sikhs held 78 per cent of gazetted appointments compared to the

Muslim' 22 percent.²⁴ As regarded the existing proportion of Muslims representation in the services some of the most striking instances are quoted:²⁵

¹⁴ Fazal Hussain, *Kashmir Aur Dogra Raj 1848-1931* (Urdu), Srinagar, (1931), 1980, edition, p. 153

¹⁵ Saraf, *Kashmiris Fight For Freedom*, Vol. 1, Saraf, Lahore, 2005 (edition), p. 303

¹⁶ Sultan Pampori, *Kashmir In Chains*, Srinagar, 1992, p. 52. Also G M. D. Sofi. *Kashir Being a History of Kashmir*, New Delhi, 1974, p.570.

¹⁷ M. Rai, op. cit., p. 175-76.

¹⁸ Ibid.

¹⁹ G.L. Koul, *Kashmir Through Ages (5000 B.C. To 1965)*, Srinagar, 1963, p. 123.

²⁰ R. Taseer, *Tahrikh-i- Hurriyat-i- Kashmir* (Urdu), Vol. 1(1931-39) Srinagar, 1968, p. 67.

²¹ C. Zutshi, *Languages of Belonging; Islam, Regional Identity, and the Making of Kashmir*, Delhi, 2003, p. 71.

²² F. Hussain, op. cit., pp. 108-09.

²³ Younghusband, *Kashmir*, op. cit., p. 186. The representation of the Muslims in the State services was inadequate, *Glancy Commission Report*, p. 18.

²⁴ Memo. By Resident, dated 6 October, 1931. IOR, R/1/29/780. cited in Ian Copland, 'Islam and Political Mobilization in Kashmir, 1931-34, *Pacific Affairs*, Vol. 54, No. 2(Summer, 1981), pp. 228-259, p. 233.

²⁵ *Glancy Commission Report*, p. 18.

Department (Executive)	Non-Muslims	Muslims
Public Works	183	54
Electric and Mechanical	47	3
Telegraph and Telephones	73	7
Customs (Assistant Mahakdars and Upwards)	195	14
Revenue(Wazirs and Tehsildars)	67	22
Revenue(Girdawars and Patwaris) Mirpur	131	31
Revenue(Girdawars and Patwaris) Reasi.	85	9
(Clerical)		
Finance	368	29
Public Works	194	3
Judicial	162	21
(Menials)		
Public Works	120	23
Customs	314	108
Forest	784	278
Stationary and Printing	66	5

(Source: Glancy Commission Report, p. 18)

There was no Muslim gazetted officer in most of the departments, like defence, hunting, scientific research, libraries, archaeology and agriculture.²⁶ Thus the majority community of Muslims in Kashmir found themselves unrepresented under the British sponsored Dogra rule.²⁷ Not to talk about the higher posts in the administration, the Muslims were even not employed in the lower posts. In early 1870's there was no Muslim occupying even a lowest position or clerk in the employ of Maharaja's Government. It is here necessary to mention that at that time Persian was the official language of Kashmir, and according to Lawrence, many villagers (Muslims) would speak and write good Persian.²⁸ While as the Muslims were not employed in the administration, they were to do menial work, and were 'the hewer of wood and drawer of water.'²⁹ The Kashmiri Pandits though in minority dominated the administration particularly the revenue department.³⁰ Since the Pandits occupied the

administrative jobs, it gave them political power and authority.³¹ The Rajputs who being the brethren of the Maharaja, were appointed in the high posts in the administration, although, they were mostly illiterate.³² Although there were many Muslims from Punjab in the administration, they either were too much loyal to represent Muslim grievances or were not enjoying actual power.³³

In 1930, a civil service recruitment board was formed for the recruitment of candidates in the state. It laid down that only those would be recruited who belonged to a notable family and were not above 20 years of age.³⁴ It was against the Muslims because majority of them came from poor family or middle class, not notable family and they because of illiteracy would start education late of their age. The government had also veto to reject an appointment of any candidate. More over the recruitment board could appoint only 40% positions while as 60% was the monopoly of the government.³⁵ Also in place of Persian and Urdu, Hindi and Sanskrit with which Muslims were not familiar, were introduced as optional languages.³⁶ Even then the working of the recruitment board was not satisfactory.³⁷ Even

²⁶ Presidential address by Sheikh Atta Mohammad, All India Muslim Kashmir Conference (Amritsar), published in *Siyasat*, Lahore, November 7, 8, 1923. For further details see Saraf, op. cit., pp. 326-28.

²⁷ M Rai, op. cit., p. 4.

²⁸ Lawrence valley *The Valley of Kashmir*, Srinagar, 1967, p. 229.

²⁹ Bazaz, Kashmir, op. cit., p. 250.

³⁰ See Lawrence, op. cit., also Bates, op. cit., pp. 96-98.

³¹ Bazaz, *Kashmir*, op. cit., p. 282.

³² Bazaz, op. cit., p. 298.

³³ M. Y Ganai, *Kashmir's Struggle for Independence, 1931- 1939*, Srinagar, 2003, p 22.

³⁴ Rashid Taseer, op. cit., pp. 79-80.

³⁵ Ibid.

³⁶ S. Abdullah, , *Aatishi Chinar*, Srinagar, 2006 (edition, p. 47.

³⁷ *Glancy Commission*, p. 22

if some Muslims were able to get Government employment but they were never promoted.

Instead the Hindus from other departments were brought to that department, where the promotion of a Muslim was due.³⁸ Moreover they were sent to distant areas without increasing their pay.³⁹ The Kashmiris were also disqualified for military services⁴⁰ and it became the monopoly of Dogras.⁴¹ Under the State's Arms Act, only Rajputs and Dogras were permitted to own and utilise fire arms,⁴² to use them against the Kashmiri people.⁴³ It seemed that British too were not in favour of Muslims in the army. One object of the Treaty of Amritsar was to establish a strong Rajput power in Jammu and Kashmir, which would achieve the British Government of the defence of a difficult country.⁴⁴

Besides being, Hindu centric, the Dogra rule was also region centric. They considered Kashmir as the purchased territory and Jammu as home country. In a letter dated 13 December, 1918, to his Chief Minister, Maharaja Pratap Singh wrote, "as you are already aware the proprietary rights in all the lands of Kashmir belong to the ruling chief exclusively, for the simple reason that the territories of Kashmir were purchased by my late lamented grandfather, Maharaja Gulab Singh, and hence any sale of such land by anyone else is illegal."⁴⁵ Ranbir Singh made Jammu his capital and thus for the first time in the history of Kashmir, Srinagar lost its importance.⁴⁶

III. EDUCATION

In the field of education, Kashmir was lagging behind in the whole subcontinent.⁴⁷ The modern education started in Kashmir with the coming of Christian Missionaries. In 1880, J. H. Knowles founded the first Christian Missionary School in Srinagar and the mission ladies founded the first girls' school at Fateh Kadal in Srinagar.⁴⁸ But it were the Kashmiri Pandits who

took lead in modern education.⁴⁹ The Pandits were advanced in education because of the facilities provided by the Government which were not provided to the Muslims.⁵⁰ In 1891-92 the condition of education was like this. Out of a population of 52,576 Hindus, 1327 were receiving State education and out of 757,433 Muslims, only 233 obtained benefit from the State schools. That is although the Hindus formed only 7 per cent of the population, they had monopolies over 83 per cent of the education bestowed by the State.⁵¹ Thus Muslims were backward in education. Many causes have been put forward for this backwardness. According to Lawrence, the villagers (Muslim) preferred Masjid schools, and stressed on moral education.⁵² Also there was apprehension about the Christian missionary schools.⁵³ But the main cause was the indifference of the government towards the education of the Muslims.⁵⁴ As the services of the Government were closed to them, they did not send their children to schools⁵⁵ for even after getting education they would remain unemployed.⁵⁶ Bazaz, a Kashmiri Pandit criticised the Dogra Government for its indifference towards education among the Muslims and not working for the welfare of Kashmiri Muslims and held the Government responsible for the backwardness of Muslims.⁵⁷ Out of 2 ½ crore income, only 15 lakh were spent on education.⁵⁸ But mostly non-Muslims were benefited from this expenditure because of their dominant presence both as teachers and students.⁵⁹ Moreover schools were not established in those areas where Muslims were in clean majority. Ironically, the schools in the Muslim areas were shifted from there to non-Muslim areas.⁶⁰ The aid given to Muslim schools was low than given to other schools.⁶¹

³⁸ *Inquilab*, 5 October, 1930, Lahore.

³⁹ *Vakil*, Amritsar, 29 November, 1923.

⁴⁰ G.L. Koul, op. cit., p.106.

⁴¹ Even outsiders were recruited in the army, Bazaz, *Kashmir*, op. cit., p. 95.

⁴² *Jammu and Kashmir Administrative Report*, 1931, pp. 6-10, JKA.

⁴³ Bazaz, *Freedom Struggle*, op. cit., p. 136-7.

⁴⁴ *Gazetteer of Kashmir and Ladakh*, op. cit., p. 138, see also art 4 of the treaty of Amritsar.

⁴⁵ Kashmir Government Records, File No. 191/H-75, block C of 1906, cited in Bamzai, p. 718. As has been already discussed in case of peasantry.

⁴⁶ A. S. Anand, *The Constitution of Jammu and Kashmir, and Its Development and Comments*, Delhi, 1998(3rd edition), p. 14.

⁴⁷ *The Hamdard*, Srinagar, 17 May, 194; Lawrence, *Valley*, op. cit., p. 229.

⁴⁸ Ishaq Khan, op. cit., p. 162 and 167.

⁴⁹ *Ibid*, p. 171. Muslims were cultivators whose responsibility was to feed the State and Pandits by producing food and the later had to rule over them by entering into administration, *Muslim Outlook*, 5 May, 1923. Cited in V. Schofield, op. cit., p. 95.

⁵⁰ Bazaz, *Kashmir*, op. cit., p. 96; for data see Lawrence, op. cit., p 229 and Biscoe, *Autobiography*, op. cit., p. 52.

⁵¹ Lawrence, op. cit., pp. 228-29.

⁵² *Ibid*, p. 229

⁵³ Ishaq Khan, *History of Srinagar*, Srinagar, 2007, pp. 150-51.

⁵⁴ *Ibid* p. 171.

⁵⁵ Biscoe, *Autobiography*, op. cit., p. 52.

⁵⁶ M. F. Hussain, op. cit., pp. 117-18.

⁵⁷ See Bazaz, *Kashmir*, op. cit., pp. 251-52.

⁵⁸ M. F. Hussain, op. cit., p. 112.

⁵⁹ *Ibid*.

⁶⁰ See *ibid*, pp. 114-16.

⁶¹ *A Note on Education in the State of Jammu and Kashmir, (Sharp Commission Report)*, Superintendent Government Printing, Calcutta, India, 1916, p. 41.

With the turn of the century the Muslims became conscious and started thinking about their community.⁶² They sent petitions and requested the Government to establish the schools in their areas, but were turned down.⁶³ The outside Muslims also highlighted the grievances of Kashmiri Muslims and supported them through their organisations, press and other means.⁶⁴ In September 1913-4 a deputation of the All- India Muhammadan Educational Conference presented an address to Maharaja Pratap Singh. Among other things, it demanded free and compulsory primary education, assistance to enable the Islamic school to be raised to the collegiate grade, the grant of special stipends and scholarships for Muslims, the employment of Muslim professors, teachers, inspectors, etc., and the appointment of special inspector for Muslim education.⁶⁵ Consequently, under pressure of public opinion, Pratap Singh, in 1916 invited Sir Henry Sharp, the Educational Commissioner, Government of India, to examine the educational system in Kashmir and to advise the future policy,⁶⁶ and also to recommend for the development of education of the Muslims.⁶⁷ Mr Sharp admitted that the Muslims were educationally backward. The following figures merely analyse the nature of its backwardness. Muslims form 75.9% of the total population of the state; in the Kashmir province the proportion rises to 94%” but their proportion in the educational field was very low. “Only 15 per mile of male Muslims and nil per mile female Muslims were found literate in 1911 and, against 38 and 1 per mile for the whole population. Only 39.55 per cent of the pupils in public institutions are Muslims. “Even in primary schools the percentage of Muslim pupils [was] far below what it normally should be.”⁶⁸ The proportion of Muslim students in private schools was higher than the public schools⁶⁹ because as per Mr. Sharp, Hindu teachers neglected and discouraged the Muslim students.⁷⁰ In the schools where the Mullahs had been appointed as teachers the number of Muslim students was much higher than the other schools.⁷¹ It was no surprising thus that the first recommendation Sharp Commission made was to appoint

Mullahs largely as teachers.⁷² Among the other things Sharp recommended, the expansion of the primary schools, scholarships for the Muslims.⁷³ Though Pratap Singh accepted these recommendations⁷⁴ but were given never due publicity and were to a great extent ignored.⁷⁵ The officials who were Hindus’ ignored these recommendations because they did not want Muslims to be appointed in the State services, which they considered their own monopoly.⁷⁶ Instead of implementing the recommendations of the Sharp Commission, they did opposite. At the time of Mr Sharp there was a special Inspector for Muslim education, but he was deflected from his proper work and was deputed to discharge the general duties of an ordinary, assistant inspector in a particular division.⁷⁷ Thus when in 1931-32, Glancy Commission was appointed, he found that the condition of Muslims had not improved. The proportion of the Muslims in the Education Department like other Departments was very low. The following figures substantiate it:⁷⁸

⁶² Ishaq Khan, op. cit., p. 171.

⁶³ *Akhbar Kashmiri*, 21 January, 1925; Bazaz, *Kashmir*, op. cit., p. 238.

⁶⁴ Saraf, op. cit., p. 319.

⁶⁵ *Sharp Commission*, p. 41; Bazaz, *Kashmir*, op. cit., p. 251.

⁶⁶ *Ibid.*

⁶⁷ Ishaq Khan, op. cit., p. 172.

⁶⁸ *Sharp Comm* p. 40.

⁶⁹ *Ibid.*

⁷⁰ *Ibid.*, p. 43; *Report of the Srinagar Riot Enquiry Committee, 1931*, Srinagar, p. 44. Therefore Glancy Commission recommended that the local teachers should be appointed in the villages, *Glancy Commission*, p. 13.

⁷¹ For details and figures see *Sharp Commission*, p. 44.

⁷² *Ibid.*, p. 45.

⁷³ *Ibid.*

⁷⁴ Ishaq Khan, op. cit., p. 174.

⁷⁵ *Glancy Commission*, p. 9.

⁷⁶ *Riots Enquiry Committee*, p. 43; Bazaz, *Kashmir*, op. cit., pp. 205-07.

⁷⁷ *Glancy Commission*, p. 16.

⁷⁸ *Ibid.*, p. 15.

DESIGNATION	MUSLIM	TOTAL
Teachers	718	2201
Headmasters of State Middle Schools	3	49
Headmasters of State High Schools	1	15
Professors in College	4	33
Demonstrators	1	8
Inspector Staff	3	14
Gazetted Officers	4	27

Source: Glancy Commission Report, p. 15.

In the Education Minister's Secretariat, there were 12 officials from the Secretary downwards, but none of them was Muslim.⁷⁹

Hari Singh took some measures which benefited the people. Primary education for boys in the cities of Srinagar and Jammu was made compulsory.⁸⁰ But after some time he changed his behaviour and came under the influence of some officials.⁸¹ For example, in 1927, a Scholarships Section Board was formed for the education of State subjects. It consisted of three members, but none of them was Muslim.⁸² They favoured their own community and thus in 1927, out of 12 scholarships, given only one was given to a Muslim.⁸³ Besides there were also Orphan Scholarships and 'Cow Protection' Scholarships. But here again huge discrimination was made. Out of 190 students, who were given Orphanage Scholarships, only 42 of them were Muslims and 148 were Hindus.⁸⁴ The Cow Protection Scholarship was given entirely to non-Muslims.⁸⁵ Hari Singh also established Rajput Military School in Jammu in which only Hindus were given admission.⁸⁶ The reason was that it was established by the funds of the Hindu religious gifts and the late Maharaja had ordered that it should be spent to ameliorate the condition of his own community only.⁸⁷

The doors of employment for Muslims were closed even if a qualified Muslim was there he was not employed and if employed he was given a low job and less pay as compared to his Hindu counterpart having the same qualification.⁸⁸ Thus because of their inadequate representation in Government departments Muslims had to suffer in various ways. As Bazaz, observed: "In education department the Muslims felt that that they Hindu teachers and officials would not take as much interest

in the spread of education among them as was necessary. In the medical department Muslim patients did not receive as much care as the Hindus. In the offices and courts Muslim clients were shabbily treated while the cases of Hindus were expeditiously described."⁸⁹ Time and again some influential Muslims would approach the British to intervene but of no avail.⁹⁰ In 1924 when the Viceroy, Lord Reading visited Kashmir a memorandum was presented to him regarding the sufferings of Muslims by some Muslim representatives, in which they demanded, inter alia, the abolition of *begar*, better educational facilities, good representation of Muslims in the State services, release of religious places and buildings and the proprietary rights to the peasants.⁹¹ The State Government did not tolerate it and the signatories were severely punished. Saad-ud-Din Shawl was banished from Kashmir, Khawaja Hassan Shah lost his jagir, Hassan Shah Jalali was dismissed from the office of *zaildar*.⁹² In the late 1920s, when Indians were preparing for the Civil Disobedience Movement and Purna Swaraj, and the British were ready to give more constitutional concessions to Indians, the Kashmiris were still labouring under many disadvantages. Officially their disadvantages were made known to the outside world by Sir Albion Bannerji.⁹³ Sir Albion Bannerji, the Foreign and Political Minister of Kashmir, resigned on 15th March, 1929 and in a press statement at Lahore exposed the autocratic Dogra rule and the impoverished conditions of Muslims of Kashmir. Levelling the serious allegations against the Dogra rule, he said: "Jammu and Kashmir State is labouring under many disadvantages, with a large Muhammeden population absolutely illiterate, labouring under poverty and very low economic conditions of living in the villages and practically governed like dumb driven cattle. There is no touch between the Government

⁷⁹ Ibid, p 16.

⁸⁰ Saraf, op. cit., p. 344.

⁸¹ Bamzai, *Cultural and Political History of Kashmir*, Vol. 3, Delhi, 1994, p. 722.

⁸² *Riots Enquiry Committee*, p. 17.

⁸³ Ibid.

⁸⁴ *Glancy Commission*, p. 13.

⁸⁵ Ibid.

⁸⁶ *Riots Enquiry Committee*, 48.

⁸⁷ Ibid, p. 47.

⁸⁸ Statement of the Muslim representatives of Kashmir to Glancy Commission, 1932, file no. 23/22-p.1, 1932, JKA.

⁸⁹ Bazaz, *Kashmir*, op. cit., p. 205.

⁹⁰ For instance when in 1924, the workers of silk industry observed hartal and protested against the heavy taxation, a telegram was sent to Viceroy by Mohammad. Usman, Srinagar, Kashmir. Foreign and Political Department, File No.-19(2) - p/ 1924-NAI.

⁹¹ Bazaz, *Freedom Struggle*, op. cit., p. 132; Saraf, op. cit., pp. 335-337.

⁹² Saraf, op. cit., pp. 338-39.

⁹³ Sir Albion Bannerji, a civil servant from Bengal was senior minister of the executive council of the State.

and the people, no suitable opportunity for representing grievances and the administrative machinery itself requires overhauling from top to bottom to bring it up to the modern conditions of efficiency. It has at present little or no sympathy with the people's wants and grievances."⁹⁴

Thus it becomes clear that the people of Kashmir during the Dogra rule were labouring under many disadvantages. The Muslims, who constituted the sheer majority of the total population of the State, were lagging behind in every field and were governed like dumb driven cattle. They were discriminated by the Dogra Maharajas for a simple reason that they were followers of a religion different to the Dogras. It is therefore not surprising that the political movement Kashmiris launched in 1930's under Shaikh Abdullah would take the religious colour and mosques and shrines were used as platforms

AUTHORS

First Author – Showkat Ahmad Wani, Research Scholar, Centre of Advanced Study, Deptt. of History, Aligarh Muslim, University. U.P. India,
Showkatahmad.amu@gmail.com

⁹⁴ *Civil and Military Gazette*, Lahore, 18 March, 1929. Foreign and Political Department-1929, File No. 7(5)-R/1929, NAI.

Study on the Variation of Gaseous Pollutants at the city Jabalpur

Shampa Sarkar

Environmental Research Laboratory, P.G. Department of Environmental Science, Govt. Model Science College (Autonomous), NAAC RE-Accredited – 'A' Grade, College with Potential for Excellence, UGC, Jabalpur 482001(M.P.) India

Abstract- Gaseous pollutants have now become an atmospheric component. The reason behind this is the presence of all gaseous pollutants like CO, O₃, NO₂ and CH₄ in the atmosphere in varied levels. The rapid industrial and economic activities and the use of poor technologies in the developing countries cause discharge of these gases which lead to air pollution. The site of Jabalpur is residential in nature but the presences of these gaseous pollutants are noticeable. The study of the comparative presence of these gases in the three years 2012, 2013 and 2014 infers that CO concentration was higher in the year 2014 (0.35ppm), in the other hand O₃ and NO₂ concentration was greater in the year 2013 (55 ppb and 11.45 ppb) whereas the concentration of CH₄ was higher in the year 2012 (2603ppb).

Index Terms- Gaseous pollutants, Carbon Monoxide (CO), Ozone (O₃), Nitrogen Dioxide (NO₂), Methane (CH₄)

I. INTRODUCTION

Our atmosphere is made up of many components; which are chemical, physical, gaseous as well as biological. All the components are inter-dependent. Thus the equilibrium of environment is dependent on the physical parameters of each of the gases and the resulting impact on account of the mixture. All the meteorological parameters affect the concentration of pollutants existing in air in gaseous or particulate forms. The gaseous components compose the atmosphere. These may convert to air pollutants due to anthropogenic activities exceeding their level of concentration in the air at local levels.

Today, developing countries in their efforts to match the economy of the developed nations are adopting technological methodologies which are not optimal and scientifically up to date due to the lack of technological and scientific progress. The gaseous pollutants Ozone (O₃), Carbon Monoxide (CO), Nitrogen Dioxide (NO₂) and Methane (CH₄) are the major pollutants. These pollutants can be found in any of the developing countries because of the emissions from the industries and due to rapid pollution from vehicles and traffic jams.

Ozone concentration in atmosphere is on account of natural as well as by human activities. Production of other gaseous pollutants also happens through secondary processes on account of reaction with other chemicals or gaseous components in presence of sunlight, CO, CH₄ and NO₂.

The concentration level of O₃, CO, NO₂ and CH₄ may fluctuate diurnally and seasonally. These physical variations in the ambient air occur due to fluctuation in meteorological

parameters. Thus, concentration of the gaseous pollutants and meteorological parameters are correlated. Many studies have already proven that, without the intrusion of any meteorological parameters the correlation cannot be accurate. **Stathopoulou et.al. (2008)** has observed the **impact of temperature on tropospheric ozone concentration levels in urban environments** of Athens. In the 3 monitoring stations ozone has been recorded between 1996-1997 where continuous monitoring of temperature has been recorded in 23 stations. They show linear correlation and temporal variation between ozone concentration and air temperature. Further, neural arrangement showed that temperature is a predominant parameter which affects the ozone concentration.

An emissions-based view of climate forcing by methane and tropospheric ozone has been studied by **Shindell et.al (2005)**. Increased methane and tropospheric ozone precursor emission can simulate the atmospheric composition by a coupled chemistry-aerosol-climate model. The global annual average composition response to all emission changes is within 10% of the sum of the responses to individual emissions quantity. And methane emissions have enforced by double the precursors rather than ozone.

Correlation analysis on variation characteristics of surface ozone concentration and its precursor compounds in Chongqing has been acknowledged by **Ping et.al. (2013)**. The monitoring of surface ozone concentration and the correlation between ozone precursors compounds some meteorological factors have shown positive correlation with solar radiation. VOCs (volatile organic compounds) were basically consistent with the variation of the ozone results. At the same time, there was a good negative correlation with NO_x.

In between November 2009 to December 2011 an **observational study of surface O₃, NO_x, CH₄ and Total NMHCs at Kannur, India** was done by **Nishanth et.al. (2014)**. It was found that the surface O₃ concentration was higher in afternoon and declined at night. NO_x concentration exceeded during mid-night to early morning and was low during noon. The diurnal variations of mixing ratios for NO_x and O₃ were anti-correlated. In December, the monthly average of CH₄ concentration was maximum (2.26 ± 0.44 ppmv) whereas in August it was minimum (0.43 ± 0.19 ppmv). The concentration of CH₄ was similar to NO_x which generally obtained in the early morning.

Jayamurugan et.al. (2013) has studied on the **influence of temperature, relative humidity and seasonal variability on ambient air quality in a coastal urban area** with respect to meteorological parameters. At North Chennai, during monsoon, post-monsoon, summer and pre-monsoon seasons (2010-11),

SO₂ and NO_x were shown negative correlation in summer while positive correlation during post-monsoon season with temperature. In addition to this, RSPM and SPM had positive correlation with temperature in all the seasons except post-monsoon one. The influence of temperature on gaseous pollutants (SO₂ & NO_x) was effective in summer than other seasons, due to higher temperature range.

Analysis of Diurnal and Seasonal Behavior of Surface Ozone and Its Precursors (NO_x) at a Semi-Arid Rural Site in Southern India was given by Reddy et.al. (2012). In the selected site of Anantapur- surface O₃, NO, NO₂ and NO_x. The O₃ concentration was highest monthly mean in April (56.1 ± 9.9 ppbv) and lowest in August (28.5 ± 7.4) ppbv. Seasonal variation in ozone concentration was highest in summer (70.2 ± 6.9 ppbv) whereas lowest in season (20.0 ± 4.7 ppbv). Other than this, higher NO_x shows in winter (12.8 ± 0.8 ppbv) while lower in the monsoon season (3.7 ± 0.5 ppbv). The concentration of ozone shows positive correlation with temperature, and a negative correlation with both wind speed and relative humidity. In contrast, NO_x shows positive correlation with humidity and wind speed, in addition, negative correlation with temperature.

Mansouri et.al. (2011) has studied on **the ambient concentrations of air quality parameters (O₃, SO₂, CO and PM₁₀) in different months in Shiraz city, Iran**. The monthly variation investigation has been done for ozone, sulphur dioxide, carbon monoxide and particulate matter in Shiraz city. Data of the selected air pollutants are continuously monitored from the two stations during 2006-2009. As a result, mean monthly concentration of CO and PM₁₀ was higher concentration in summer season rather than cold.

II. SIGNIFICANCE OF THE STUDY

The study is significant to gain information about the ambient air quality of the city Jabalpur. The observation has continuously monitored by AAQMS (Ambient Air Quality Monitoring System). In the upcoming years, AAQMS is going to enforce in each cities to aware the population about its importance and necessity.

III. MATERIAL AND METHOD

The Study Area:

Madya Pradesh is generally known as the heart of India. The site Jabalpur is one of the major centers of Madhya Pradesh in India and is famous for its green belt. Geographically, it is located at $23.17^{\circ}N$ $79.95^{\circ}E$. It has an average elevation of 411 meters (1348 ft). Topographically Jabalpur is rich with forests, hills and mountains which contain lots of minerals in it. On the other hand, quality of air is getting deteriorated slowly by increasing industrialization and due to tremendous increase in number of vehicles plying on the roads.

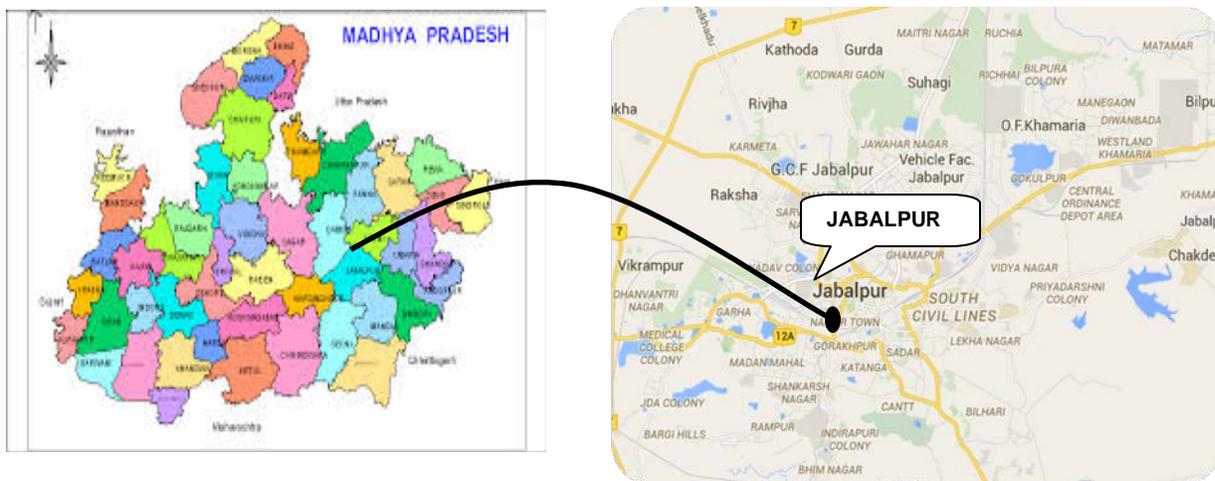


Fig. 1: Location of Jabalpur

Sampling and Investigative method:

The instrument **Ambient Air Quality Monitoring System (AAQMS)** was manufactured by **Ecotech** Australia. It is systematic, assessment of long term pollutants in the surroundings. **Ecotech** established the instrument for environmental monitoring that is WinAQMS (Air Quality

Monitoring Station). This WinAQMS has two parts: the client and the server. The monitoring system consists of the assembly of many transducers and analyzers employing various instrumentation techniques. These are:

1. EC9830 Carbon Monoxide Analyzer (CO):

Carbon monoxide absorbs infrared radiations (IR) at wavelengths near 4.7 microns; therefore, the presence and the amount of CO can be determined by the amount of absorption of the IR. The absorption spectrum between the measured gas and other gases present in the sample is analyzed to determine the concentration of Carbon Monoxide.

2. Carbon Monoxide (CO) Analyzer - NDIR Gas Filter correlation technique:

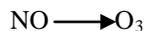
The EC9830 analyzer operates by measuring CO absorption of IR radiation at highly specific wavelengths near 4.7 microns. The broad infrared radiation (IR) that is absorbed by the CO is within the 5-meter folded path-length. The gas filter correlation wheel facilitates rejection of interference and the narrow band pass filter ensures measuring only the CO sensitive IR wavelengths. The CO content of the sample is continuously measured from a user-supplied air stream of which the instrument extracts 1 SLPM (standard liter per minute) of sample. The reference cell contains 100% CO and the measurement cell contains 100% Nitrogen (N₂).

3. EC9810 Ozone Analyzer (O₃):

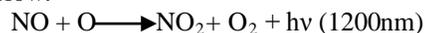
The ozone analyzer determines ozone concentrations by measuring the amount of ultraviolet light that the ozone absorbs. Ozone exhibits strong absorption in the ultraviolet spectrum around 250 nanometers (nm). The EC9810 ozone analyzer exploits this absorption feature to accurately measure ozone concentrations to less than 0.5 ppb. A stream switched, single beam photometer serves as the basis for the EC 9810. The ultraviolet light is detected by a photodiode that only responds to ultraviolet energy. The photodiode converts ultraviolet light to electrical signal that is proportional to ultraviolet light detected.

4. EC9841 Nitrogen Oxides Analyzer (NO_x):

The EC9841 analyzer uses gas-phase chemiluminescence detection to perform continuous analysis of nitric oxide (NO), total oxides of nitrogen (NO_x), and nitrogen dioxide (NO₂). The EC9841 design represents an advance in nitrogen oxides analysis technology achieved primarily by using adaptive microprocessor control of a single measurements channel. The instrument consists of a pneumatic system, an NO₂ to NO converter (Molygon), a reaction cell, detector (PMT), and processing electronics. The analysis for NO by chemiluminescence detector is the best direct technique. The operation is based on the chemiluminescence of activated molecular nitrogen dioxide species produced by the reaction between



in an evacuated reaction cell. The NO reacts with O₃ to form the activated NO₂ species in accordance to the reaction mechanism shown below:



The chemiluminescence reaction is between O₃ and NO only. In order to measure the NO_x (NO + NO₂) component of the sample the NO₂ must be reduced to NO prior to its entry to the reaction cell. This process is accomplished by the Molycon catalytic converter.

NO₂ Converter:

The NO₂ concentration is derived by subtracting the NO signal from the NO_x. To obtain accurate and stable results, the converter must operate at above 96% (US EPA) and (95% Australian standard) efficiency. The Molybdenum converter will operate at nearly 100% efficiency for in excess of 8000 ppm-hours. Maximum conversion at 99% efficiency is 7 ppm NO₂. For higher NO₂ levels a stainless steel converter that operates at 650 °C is required.

5. GC ALPHA 115 Methane/TNMHC:

Dimensions:

The instrument is built for a 19" rack. It is advised to reserve an extra-space of 1 standard HU (at a bottom and on a top) for the instrument ventilation and to mount the arrangement on a rail.

Gas fittings:

Pressure regulators must be of gas chromatographic quality i.e. must be dust free and should not absorb or emit hydrocarbons.

Gases needed for Alpha 115:

It is use of a combination of hydrogen and zero air generators. The zero air must be equipped with a catalytic methane scrubber.

FID detector needs hydrogen flame to generate a signal. For this purpose hydrogen and clean air are needed. Zero air is also used as carrier gas in a column.

Observation Table:

The site for the study is quite dense related to residential area but the place of Jabalpur is also very near to green belt. While on monitoring the ambient air by AAQMS (Ambient Air Quality Monitoring System) of the city, some gaseous pollutants are found like ozone (O₃), carbon monoxides (CO), methane (CH₄) and nitrogen dioxide (NO₂). The observation of gaseous pollutants has been taken from the three consecutive years 2012, 2013 and 2014. Here, the observation tables are showing the annual average of the O₃, CO, NO₂ and CH₄:

Table 1: Annual average of Gaseous Pollutants of the year 2012

MONTH	CO ppm	O3 ppb	NO ₂ ppb	CH4 ppb
JAN	0.24	44	11.11	2807
FEB	0.20	51	6.83	2744

MAR	0.18	50	6.36	2678
APR	0.33	53	7.14	2684
MAY	0.24	55	6.00	2432
JUN	0.20	53	5.86	2127
JUL	0.18	40	6.22	3097
AUG	0.20	31	8.15	2395
SEP	0.19	37	8.10	2750
OCT	0.20	49	9.10	2639
NOV	0.27	56	14.78	2832
DEC	0.24	57	12.53	2049
Annual Avg.	0.22	47.99	8.51	2603

Table 1: Annual average of Gaseous Pollutants of the year 2013

MONTH	CO	O3	NO ₂	CH4
	ppm	ppb	ppb	ppb
JAN	0.27	59	14	1327
FEB	0.18	52	12	2196
MAR	0.21	62	11	1465
APR	0.24	63	11	1388
MAY	0.23	41	13	2005
JUN	0.19	48	9	1765
JUL	0.17	33	10	2081
AUG	0.17	54	10	2407
SEP	0.11	53	12	2686
OCT	0.17	48	10	2564
NOV	0.16	66	14	2651
DEC	0.22	53	10	2598
Annual Avg.	0.19	53	11	2094

Table 3: Annual average of Gaseous Pollutants of the year 2014

MONTH	CO	O3	NO ₂	CH4
	ppm	ppb	ppb	ppb
JAN	0.29	59	14	3261
FEB	0.33	50	13	3303
MAR	0.28	54	11	3131
APR	0.50	58	11	3276
MAY	0.58	50	11	2186
JUN	0.56	39	10	2318

JUL	0.32	28	9	2140
AUG	0.19	12	9	1626
SEP	0.22	8	8	1830
OCT	0.30	13	10	2198
NOV	0.31	17	10	2516
DEC	0.30	15	10	1623
Annual Avg.	0.35	34	10.36	2451

After obtaining the data, it can be easily estimate the maximum concentration of the pollutants annually. The fluctuation in the concentration level may be due to the respective fluctuation of other pollutants. In addition to this, the physical aspects are very much essential factor to counstrucing a ambient air. Thus, the comparative representation of all the gaseous pollutants of the three consecutive years (i.e. 2012, 2013 and 2014) in the atmosphere of Jabalpur has been shown here under:

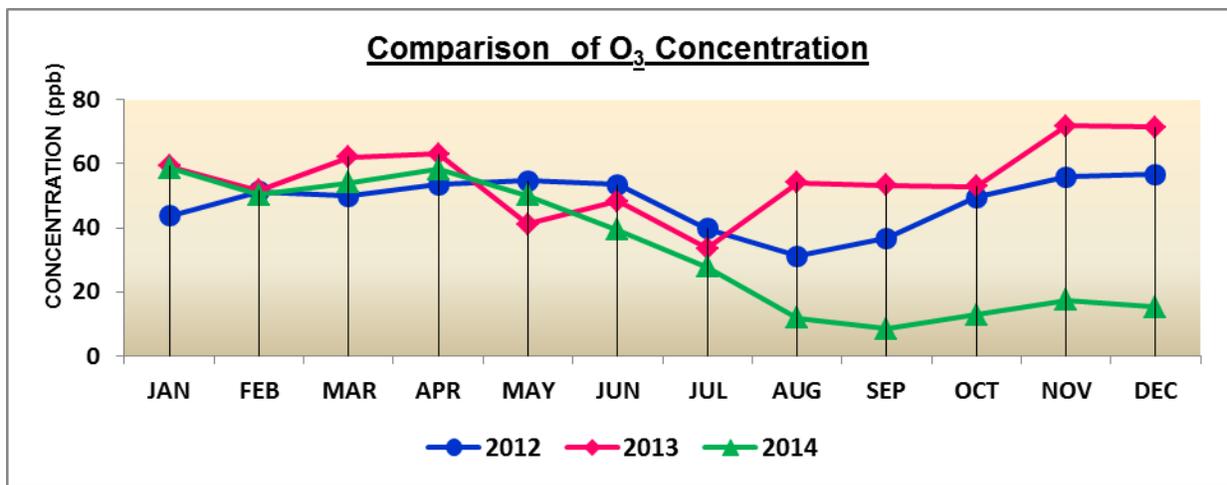


Fig. 1: Comparison of the three year annual average of O₃ concentration

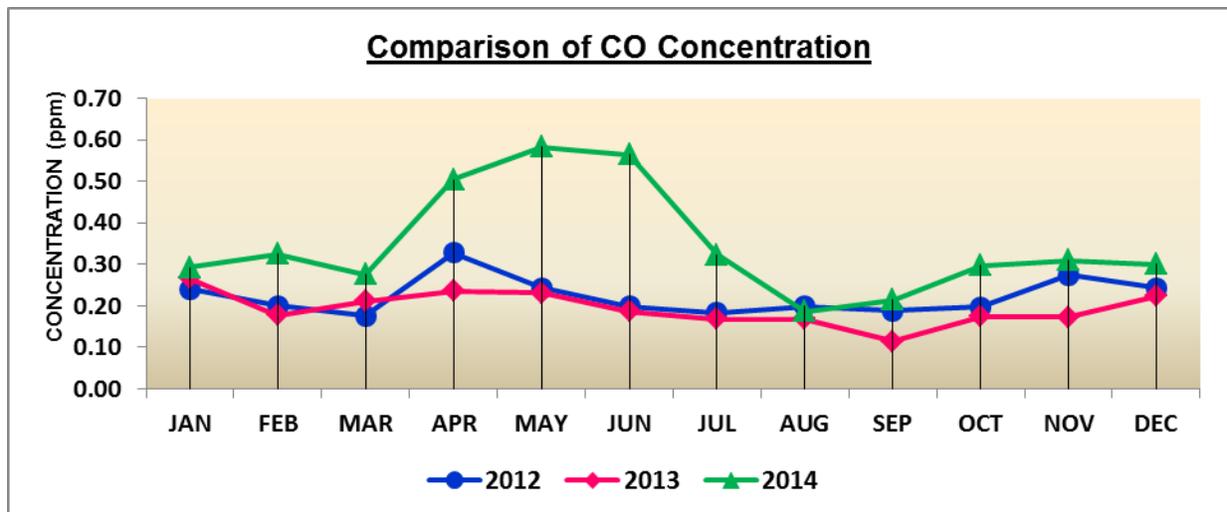


Fig. 2: Comparison of the three year annual average of CO concentration

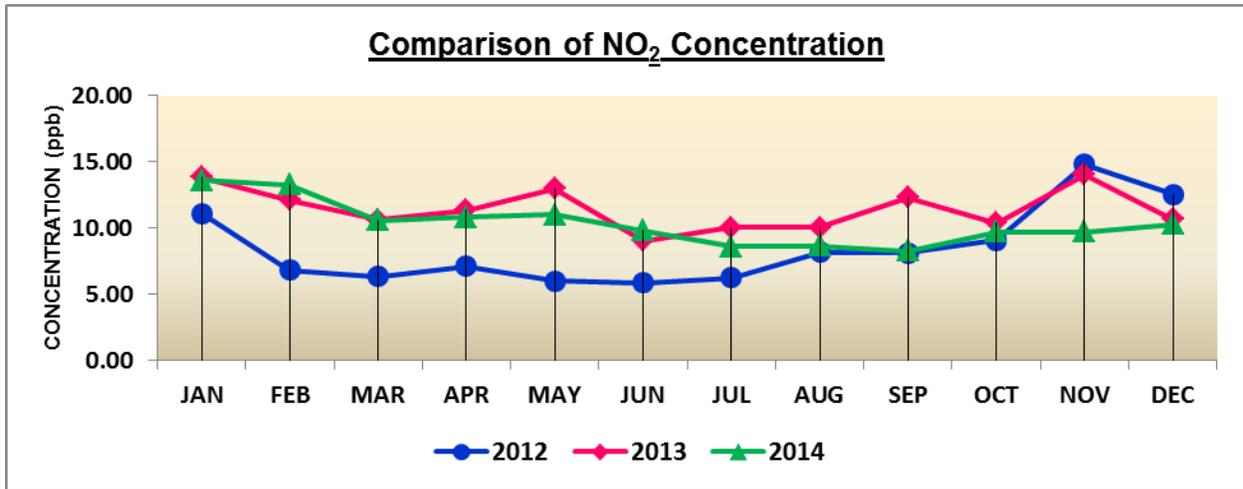


Fig. 3: Comparison of the three year annual average of NO₂ concentration

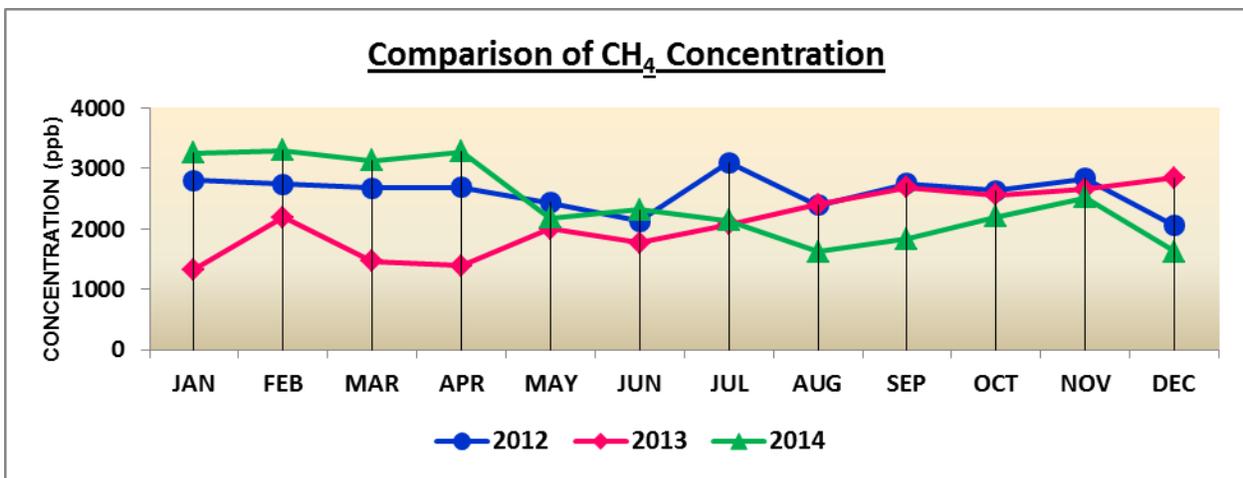


Fig. 4: Comparison of the three year annual average of CH₄ concentration

In the above graphs there has a peak value present which can easily find out and recorded. While on doing further studies or calculations this maximum or minimum levels are must be needs. Because in the study the lowest concentration can figure out the reason behind the fluctuation. While on comparing the level of pollutants with respect to its concentration can be effortlessly understood by the figure which pointing the average concentration of air pollutants like CO, O₃, NO₂ and CH₄:

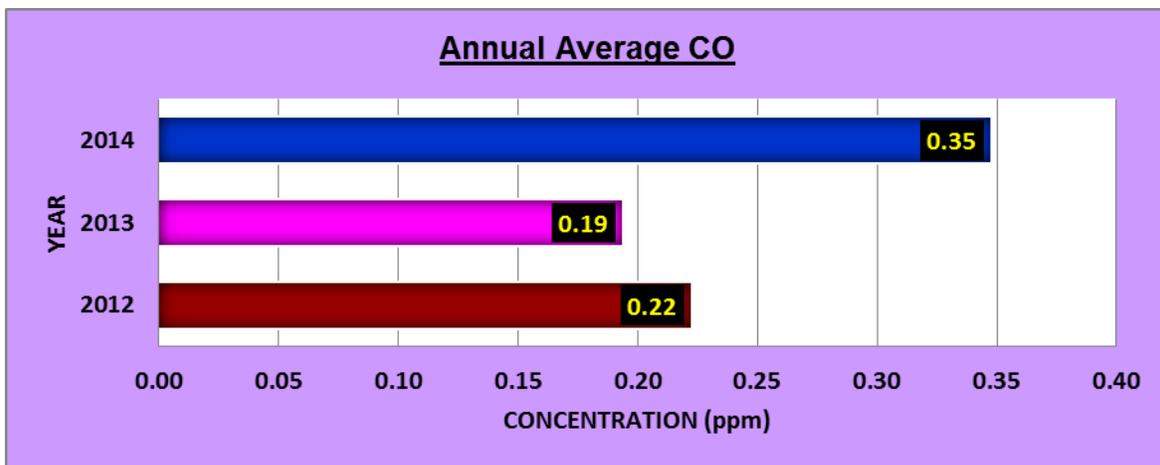


Fig. 5: Three year annual average of CO concentration

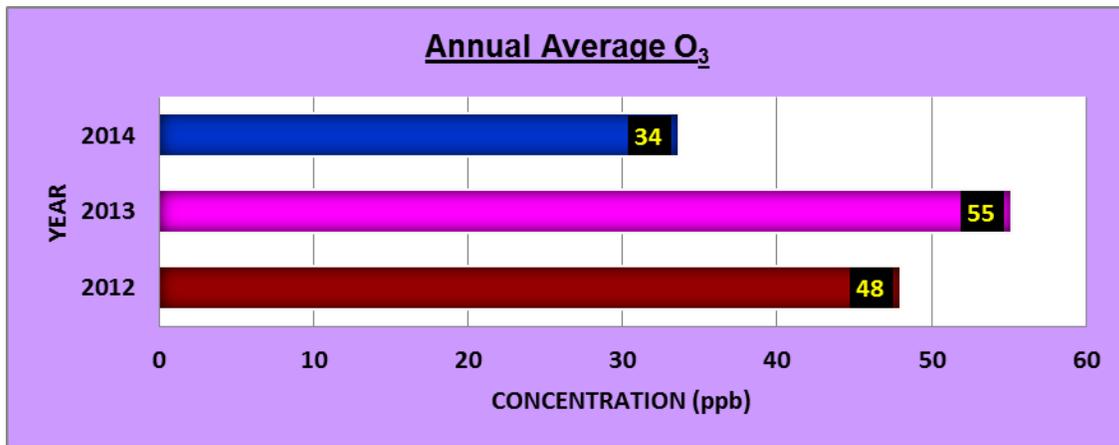


Fig. 6: Three year annual average of O₃ concentration

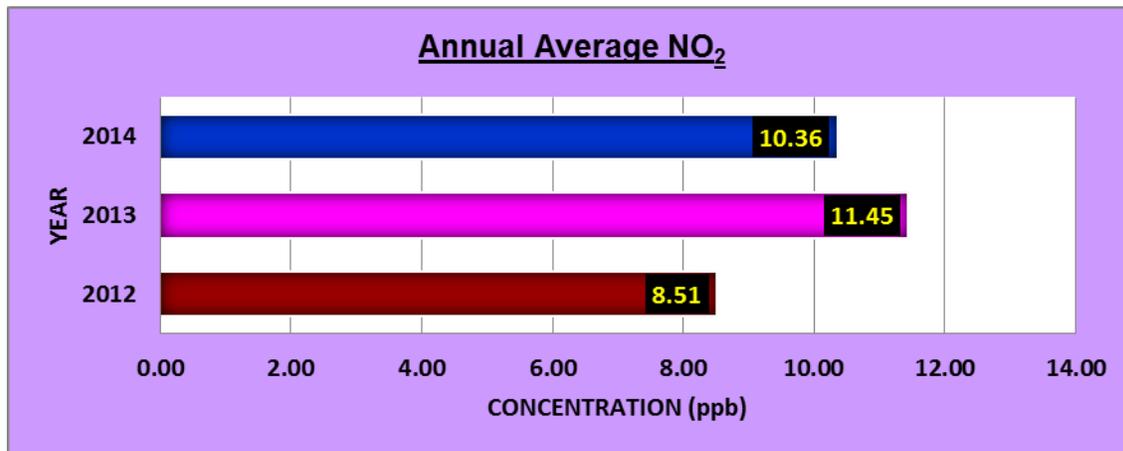


Fig. 7: Three year annual average of NO₂ concentration

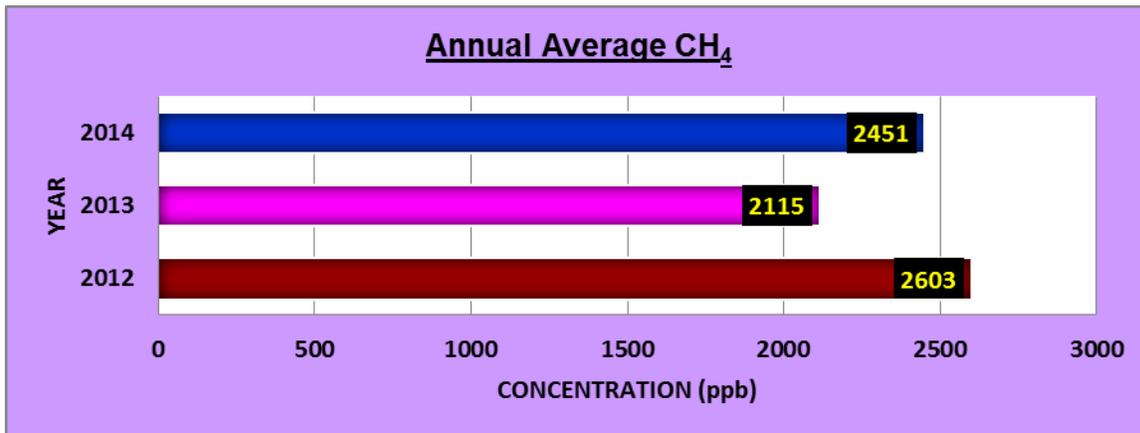


Fig. 8: Three year annual average of CH₄ concentration

IV. RESULT AND DISCUSSION

The study provides all the essential information's about the air quality of Jabalpur. Three years i.e. 2012, 2013 and 2014 data shows fluctuation during day and night (diurnal). In addition to this, the annual average performs the climatic condition of the city. In the year 2012, maximum CO, O₃, NO₂ and CH₄ concentration has recorded upto 0.33 ppm (April), 57 ppb (Dec.),

14.78 ppb (Nov.) and 3097 ppb (July) respectively from Table 1. In the 2013, from Table 2: the concentration vary from 0.27 ppm (Jan.), 66ppb (Nov.), 14ppb (Jan. and Nov.) and 2686ppb (Sep.) whereas in 2014, the observation goes towards 0.58ppm (May), 59ppb (Jan.), 14ppm (Jan.) and 3303ppb (Feb.) showing in Table 3.

Incase of annual average concentration, CO was higher (0.35 ppm) in the year 2014 rather than 2012 and 2013 (Fig. 5). Concentration of O₃ and NO₂ is more in 2013 i.e. 55 ppb and

11.58 ppb respectively from Fig. 6 and 7. Whereas, in the year of 2012 methane (CH₄) concentration was increased upto 2603 ppm (Fig. 8). It has been noticed that ozone concentration was higher in afternoon and decreasing at night (Nishanth et.al.). The comparative study of the gaseous pollutants from (Fig. 1, 2, 3 and 4) the three consecutive selected years shown that the fluctuation in concentration may be vary due to the climatic condition and simultaneous because of the fluctuation in concentration of other pollutants.

ACKNOWLEDGEMENT

The author express our regards to Indian Institute of Tropical Meteorology (IITM), Pune to install the Ambient Air Quality Monitoring System (AAQMS) in Environmental Research Laboratory of Government Model Science College (Autonomous) Jabalpur, which helped a lot in the present study. Special acknowledgement towards Dr. R. K. Srivastava for his guidance and encouragement. Words are shorts to express my thanks to college colleagues and senior researchers.

REFERENCES

- [1] Jayamurugan, R., Kumaravel, B., Palanivelraja, S. and Chockalingam, M.P. (2013). Influence of Temperature, Relative Humidity and Seasonal Variability on Ambient Air Quality in a Coastal Urban Area. *International Journal of Atmospheric Sciences*. Vol. 2013, Article ID 264046, 7 pages.
- [2] Nishanth, T., Praseed, K.M., Satheesh Kumar, M.K., Valsaraj.K.T. (2014). Observational Study of Surface O₃, NO_x, CH₄ and Total NMHCs at Kannur, India. *Aerosol and Air Quality Research*. Vol. 14, pp. 1074–1088.

- [3] Shindell, D.T., Faluvegi, G., Bell, N. and Schmidt, G.A. (2005). An emissions-based view of climate forcing by methane and tropospheric ozone. *Geophysical Research Letters*. Vol. 32, Issue 4.
- [4] Stathopoulou, E., Mihalakakou, G., Santamouris, M. and Bagiorgas, H.S., (2008). On the impact of temperature on tropospheric ozone concentration levels in urban environments. *Journal Earth System Science*. Vol. 117, pp. 227-236.
- [5] Mansouri. B., Hoshiyari. E., and Mansouri. A. (2011). Study on ambient concentrations of air quality parameters (O₃, SO₂, CO and PM₁₀) in different months in Shiraz city, Iran. *International Journal of Environmental Sciences*. Vol. 1, No 7, May, pp 1440-1447.
- [6] Reddy, B.S.K., Kumar, K.R., Balakrishnaiah, G., Gopal, K. R., Reddy, R.R., Sivakumar, V., Lingaswamy, A.P., Arafath, S.Md., Umadevi, K., Kumari, S.P., Ahammed, Y. N. and Lal, S. (2012). Analysis of Diurnal and Seasonal Behavior of Surface Ozone and Its Precursors (NO_x) at a Semi-Arid Rural Site in Southern India. *Aerosol and Air Quality Research*. Vol. 5(12), pp. 1081–1094.
- [7] Ping, L., Chongzhi, Z., Jiayan, Y., Lei, B. and Wei, H. (2013). Correlation Analysis on Variation Characteristics of Surface Ozone Concentration and its Precursor Compounds in Chongqing. *Environmental Science and Management*. Chongqing Environmental Monitoring Center, Chongqing 401147, China.

AUTHORS

First Author – Shampa Sarkar, Environmental Research Laboratory, P.G. Department of Environmental Science, Govt. Model Science College (Autonomous), NAAC RE-Accredited – ‘A’ Grade, College with Potential for Excellence, UGC, Jabalpur 482001(M.P.) India

Patient Waiting Time in Emergency Department

Sreekala P*, Arpita Dan**, Elizabeth M Varghese**

*School of Nursing, CH (WC), Chandimandir, India

** College of Nursing, INHS, ASVINI, Mumbai, India

** College of Nursing, AFMC, Pune, India

Abstract- The emergency department is the most critical area of any hospital. The time taken for each patient for triaging, consultation and referral can affect the disease outcome of the patient. The present study was undertaken to determine the average waiting period of patients visiting a tertiary level emergency department. The present study comprised 38 emergency admissions for duration of two weeks. A participatory observational method was used to collect data. The study revealed that the average total waiting period from entry till disposal was 2.46 Hours with a mean deviation of 1.26 hours. The key factors responsible for the delays are examination of patient, time taken for consultation, emergency investigations or imaging, unavailability of vehicles for transport, admission procedure etc.

Index Terms- Emergency Department, Patient, Waiting time

I. INTRODUCTION

A Hospital is an integral part of a social and medical organization, the function of which is to provide the population complete healthcare, both curative and preventive and whose outpatient services reach out to family and its home environment, hospital is also a centre for training of health workers and biosocial research.¹ Patients who check into a hospital's emergency room (ER) often experience long wait times in an emergency room waiting area. These wait times are due to the triage process that is requisite to hospital admission, patient "boarding" (waiting for a bed), a shortage of on-call physicians and the pile-up of emergency patients due to local accidents and disasters. As ER wait times can lead to delayed treatment of patients who require immediate medical care, hospitals must focus efforts on reducing the amount of time patients must spend in the waiting area⁶. The average time that hospital emergency room patients wait to see a doctor has grown from about 38 minutes to almost an hour over the past decade, according to new federal statistics in 2012. According to CDC report, about 119 million visits were made to U.S. emergency rooms in 2006, up from 90 million in 1996 causing a 32 percent increase emphasizing more organized patient management in emergency department.

The researchers undertook the present study to determine the average waiting time of patients reported in the emergency department and to assess the factors responsible for the waiting period of patients in emergency department. The need of the study was conceived from the verbal report and grievances of patients visiting the emergency department and researcher's personal observation made during emergency department rounds.

II. MATERIALS & METHODS

The study was a cross sectional observational study using a semi structured observational checklist which was validated by a panel of experts. A non probability convenient sampling was used to select the patient reporting to emergency department. The researchers were participating in the patient care activities of emergency department during collection of data and observed the disposal of patients. Observation was concealed to the health care personnel who involved in the care and disposal of patients to limit bias in the study.

A formal permission obtained from Medical Officer in charge Emergency Department for conducting the study who was not directly involved in the care and disposal of emergency admission. The study duration was of two weeks during day shift. Night shift observation was excluded due to feasibility factor of researchers. The descriptive statistical method was used to analyze the data using frequency, percentages, mean and Standard deviation.

III. RESULTS & DISCUSSION

The data was analyzed using descriptive statistics. A total number of 37 patients reported to emergency department during the observation period. Out of 37 patients, majority (12) reported with GI complaints (32.43%). 11 (29.73%) admission contributed to RTA/Trauma. Neurological emergencies contributed to 08 (21.62%) admissions and 03(8.1%) of emergencies reported were due to Cardiac/respiratory conditions (Figure1). Majority of the subjects 20 (51.35%) belonged to the age group of 21-40 yrs of age and majority of the sample reported were male (67.57%)

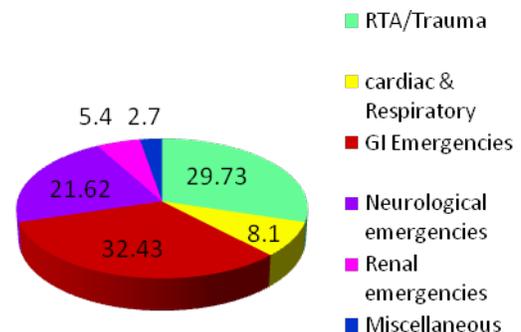


Figure 1: Type of Emergencies

The total duration of emergency department waiting time ranged from 2.25 Hrs to 2.67 hrs with mean waiting period of 2.46 Hours with a standard deviation of +/- 1.26 hours from entry till disposal. There are various factors responsible for this delayed period of disposal which is categorized further ranging from conveyance problem, consultation delay etc.

The time taken from arrival to specialist consultation ranged from 28.31 minutes to 38.33minutes with mean duration of 33.32 minutes and SD of +/- 30.47 minutes. This delay is caused mainly because the patient is first assessed by MO Emergency Department, then the specialist/ Specialist trainee is informed telephonically. The junior trainee attends the case and then the Intermediate/Senior Trainee is consulted to arrive into a decision.

The patients waiting time from specialist's arrival to consultation, investigation and decision making for final disposal ranged from 23.54 minutes to 31.42 minutes with mean duration of 27.48 minutes and SD +/- 24.0 minutes. The delay is caused due to consultation by various levels of specialist trainees who has to depend on the Specialist or senior trainees for decision making. The flow of information from one channel to another channel caused maximum delay in the decision making process.

The time taken for final disposal from specialist decision to disposal of patient had a mean duration of 1.33 Hours with SD +/- 55.36 minutes. The delay was mainly caused due to valuable time spent in documentation, admission procedures and unavailability of ambulance for transporting patient from emergency department to various wards/departments. The findings are correlating with an earlier study conducted by Bharali S in selected hospitals of Karnataka which revealed that time taken for registration affects the delayed waiting period of emergency patients.³

The causes identified (Figure 2) for delay in the disposal of patients were delay in consultation (32.43%), unavailability of ambulance (32.43%), delay in documentation (24.32%), absence of necessary identity proof from patients side (5.4%) and administrative problems like unauthorized admission, MLC cases etc. (5.4%). The consultation delay was mainly due to the delay in investigations, especially imaging procedures and subsequent delay in transportation of patient from emergency department to radiology department. The arrival of senior trainees and time taken to consult the Specialist also contributed to consultation delay in great extent. A study was conducted by Mohammed Hanaffi Abdullah in a hospital in Malaysia to determine the OPD waiting time and to investigate possible operational factors responsible for patients waiting period in the OPD's of hospital. The study revealed that there are various factors responsible for waiting period such as registration procedure, number of staff at counter and insufficient doctors.^[2] The present study also concludes that various factors such as registration procedure and decision making time affects the emergency waiting period of patients.

Unavailability of ambulance for transport of patient from Emergency Department to respective wards was another major concern for increasing the waiting period of patients. Documentation delay is mainly identified during admission procedure. Considerable time was spent in verifying the identity, completing case sheets, procuring necessary documents which contributed to increased waiting period in approximately 09 emergency cases.

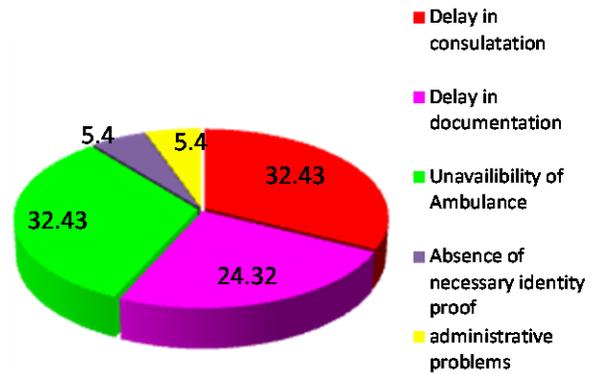


Figure 4: Causes of prolonged waiting time

IV. CONCLUSION & RECOMMENDATIONS

The present study was conducted to determine the waiting period of patients in an emergency department of a tertiary care hospital and to identify causes which contributes to the delay if any. The main cause identified contributing to waiting period are delay in decision making, registration procedure and non availability of vehicles for transportation of patients. The following recommendations are made in the present study to Consider an admission counter exclusively for emergency admission, Detail a specialist trainee from each department exclusively for emergency department only, Make provision for more vehicles to be available especially during working hours and to conduct a similar study on large samples including all emergency admissions in all shifts.

REFERENCES

- [1] E. W. Nawar, R. W. Niska, and J. Xu, "National Hospital Ambulatory Medical Care Survey: 2005 emergency department summary," *Adv Data*, no. 386, pp. 1-32, Jun 29, 2007.
- [2] Abdullah MH. Study on Outpatients' Waiting Time in Hospital University Kebangsaan Malaysia (HUKM) Through the Six Sigma Approach. Department of Statistics, Malaysia. 2005.
- [3] Bharali S. A study on reducing waiting time in the outpatient department in a selected hospital. Unpublished dissertation. Bengaluru. 2010.
- [4] Engineering Shorter Wait Times in the ER. Science daily. Aug 31. 2010.
- [5] Wenerstrom B. Analysis of Emergency Room Waiting Time in SAS. University of Louisville.
- [6] Chris. How to Reduce Wait Time in the Emergency Room. <http://www.wikihow.com/Reduce-Wait-Time-in-the-Emergency-Room>.
- [7] Amirault B. Link between emergency department wait times, cost, and quality. Dec 2012.
- [8] Park C Y, Lee M A, Epstein AJ. Variation in Emergency Department Wait Times for Children by Race/Ethnicity and Payment Source. *Health Service Research* 2009. December; 44(6): 2022-2039.
- [9] Jensen k, Kirkpatrick DG. The hospital executive guide to emergency department management. 2010.
- [10] Burns Nancy, Grove.SK. *The Practice of Nursing Research : Conduct , Critique and utilization*. 5th edition. Elsevier, Saunders. 23;548.
- [11] David.JF. *Fundamentals of Research in Nursing*. Appleton-Century Crofts. New York.1950. 6(96).7(115)

- [12] Hammand KR and Householder JE. Introduction to the Statistical Method. New York,1962. 10(108-113).
- [13] Wilson G. Social science research methods. New York. Appleton-Century-Crofts. Inc.1950.
- [14] Walker HM and Lev J. Elementary statistical methods. New York. Henry Holt & Company. 1958.14(72-77)
- [15] Simmons LW and Henderson V. Nursing research : A survey and assessment. New York. Appleton-century-croft , 1964. 1(32-36).
- [16] Rao BhaskaraT.Research Methodology 3rd edition. 14(131).21(196-198).

AUTHORS

First Author – Mrs. Sreekala P, M.Sc (N), Tutor, School of Nursing, CH(WC), E mail: k_sree16@yahoo.co.in

Second Author- Mrs. Arpita Dan, M.Sc (N), Clinical Instructor, CON, INHS, ASVINI, E mail: arpitaam@gmail.com

Third Author- Mrs. Elizabeth MV, M.Sc (N), Professor, CON, AFMC, E mail: nealyvarghese@gmail.com

A Review on Power Saving Techniques in MANET

A. Sakthi Saranya, G. Ravi

Department of Electronics and Communication Engineering- PG, Sona College of Technology, Salem.

Abstract- Mobile Ad hoc Networks (MANETS) consists of distinct devices that communicate with the help of infrastructure created instantly. When these devices are used in the areas like battlefield, emergency and rescue operations, the battery power must be efficiently used to prolong the life of each device as human intervention is not possible in such areas. There are number of ways that are used to reduce the power consumed by the nodes in the network. In this paper, the three effective methods that reduce the power to considerable extent are seen. The three methods are given as: by using variable transmission power, by using power aware routing protocol and the power management technique. These methods deal with different layers like physical, network and MAC layers respectively.

Index Terms- Mobile Ad hoc Network (MANET), Power Management Techniques, Routing, Transmission power.

I. INTRODUCTION

MANETs are the wireless sensor networks in which two different devices communicate without any base station or access points in between them. This is done with the help of instant infrastructure created between the nodes. The challenging fields of MANET include bandwidth constraint compared to networks with base stations or access points. Limited bandwidth in turn reduces the number of packets carried along the network and delivered to the destination. Also nodes are powered with the battery. Applications like battle field, emergency and rescue operations, the battery backup becomes very essential. The provided battery power is limited. Hence these devices become battery constrained devices. The power must be consumed efficiently by the devices in the network to prolong the life of the devices.

Topology changing is another major issue. In applications like collaborative works in business environment, this topology changes introduces unexpected route break which results in latency in message delivery. Here the power conservation is not a major issue but latency maintenance becomes important. The tradeoff between power and latency depends on the application where the devices are used. For MANETs, optimization of energy consumption has greater impact as it directly corresponds to lifetime of networks. The various factors that reduce the energy of the network is the transmission power as well as the reception power. Power consumption can be reduced at device level, at transmission level or by using power aware routing protocol or by using some power management technique.

In MANET, regarding the power constraint, there are several reasons behind it which limit the battery charge per node, limited transmission range per node and limited bandwidth. As MANET makes communication between two hops in multi hop manner. If

the distance between the communicating nodes is larger than it increases the power consumed or it decreases the overall life time of the network. This means that the power consumption is directly proportional to the route length. As the nodes forward the packet to their neighbor the power consumption will be increased. This means the node consumes power at each time when it transmits or receives data. Thus the nodes are forced to expend their battery charge each time when it transmits or receives the data. These constraints have vital impact in node lifetime and network lifetime. The following techniques can be used to optimize the power in the MANET.

- Power conserving by controlling transmission power
- Power conserving by using minimized power aware routing protocol
- Power conserving by using power management Technique

II. POWER SAVING BY VARYING TRANSMISSION POWER

The strength of the signal power transmitted from source to destination depends on the distance from the source node to the destination node which is mainly called as transmission range. Number of studies deals with the problem of power saving by varying transmission power or using variable transmission range method.

Jang Ping Sheu et al., in [1] discussed distributed transmission power control algorithm to vary the transmission power level that not only increases the life time of the devices but also increases the packet delivery ratio. This algorithm consists of two processes: initial phase and maintenance phase. Since the nodes are mobile the same transmission power level to all the nodes does not sound effective in terms of PDR and power consumption. Hence different power levels are selected. At various power levels the packets are initially broadcasted to all the nodes in the network. Each node depending on the Received Signal Strength Indicator (RSSI) acknowledges the source at the particular power level at which the received signal can be processed successfully without the need for retransmission. Hence the near nodes use the lowest power level and the far nodes use the highest power level. When the path chosen is multi hop, this algorithm saves power to greatest extent and gives better packet delivery ratio. This prolong the overall lifetime of the network.

Nagpal et al., in [2] compared two protocols: Multi Hop Routing (MHR) and Minimum Total power Routing (MTPR) in terms of power consumption under two scenarios: fixed and variable transmission ranges of the devices in the network. The shortest path is created using Dijkstra algorithm. The results show that the power consumed by the devices is less in the

MTPR protocol with variable transmission range with better Packet delivery ratio.

Dhinesh et al in the work [3] proposed enhanced transmission power control mechanism (ETPM) by which the transmission power is varied according to the distance between the nodes and the received signal strength indicator (RSSI). The received signal is calculated as,

$$S_r = S_t * (1/D)^n$$

S_r – Received signal power

S_t – Transmitted signal power

D- Distance between source and the destination nodes

n- Transmission factor

The above relation shows that the power of the transmitted signal decays with the distance logarithmically. Hence transmitting the packets to the nodes that are far away from the source requires more power more transmission power. This drains the life of the battery provided to the network nodes. In this paper, four power levels are considered corresponding to the distance from the source. Thus ETPM prolongs the lifetime of the node as well as the network making the communication effective without affecting the packet delivery ratio.

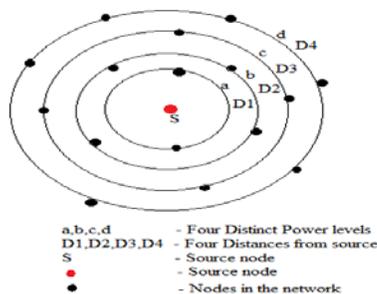


Fig. 1. Four Transmission power level MANET

In order to establish path and power level to the respective destination node, the source node first broadcasts the message at all the four power levels. The destination node in turn acknowledges the source node via shortest available path at corresponding power level that no needs retransmission. For example, the node S broadcasts all the nodes in the network. Let the destination node be at power ring “b”, then destination node acknowledges to the source node at power level “b”. It eliminates the messages received at power level “a” as it is insufficient to reproduce the message at the receiver side and also eliminates the message received at power level “c” and “d” as it demotes the battery power. Thus this system is more efficient in prolonging the battery power of the devices.

III. POWER SAVING BY USING POWER AWARE ROUTING PROTOCOL

Routing in MANET can be unicasting, multicasting or broadcasting. The path from source to destination consists of number of nodes. Thus the routing in MANET is always referred to as multi hop routing. If the destination is immediate neighbor, then there is no need of multi hopping in the route. But this is not always possible in all the cases. Every packet, in order to reach

the destination, needs defined path. In MANET, this path is given using three types of protocols: table driven, on demand and hybrid protocols. In table driven protocols, each node in the network maintains one or more tables regarding the active nodes in the route to reach the corresponding destination. An example for table driven protocols is: DSDV. In contrast to table driven protocols, in on demand protocols, the path or the route to the particular destination is created only when there is need to send packets to that particular destination by the source node. Some of the on demand protocols are: Ad hoc On demand Distance Vector (AODV), Dynamic Source Routing (DSR). Hybrid routing protocol inherits both the features of table driven and on demand protocols. One of the known protocols is Zone Routing Protocol (ZRP). On comparing the above types of protocols, On demand protocols best serves the purpose of power managing.

Sridhar et al., in [4] proposed Sensor Bee routing protocol based on swarm intelligence to reduce the power consumed by the nodes. Sensor Bee protocol reduces the routing loop which the packets takes to reach the source from destination in the reverse path. Hence the power consumed due to complex routing loop is reduced. Each node maintains a forward table entry for the packets that are passed through that particular node. If the same packet reaches the node which was previously visited during forward path, then the particular revisited packet is dropped and the entry against the particular packet is flushed out from the table. Thus the node selects the next hop with less distance and also the nodes which is not visited previously. Thus the power consumed by this sensor bee protocol less compared to the ad hoc routing protocols discussed above.

Dongkyun Kim et al., in [5] introduced a parameter called as Minimum Drain Rate (MDR) that is used to measure the rate at which the power is consumed in the network. This MDR mechanism is based on the metric drain rate and remaining battery capacity. Hence this mechanism efficiently uses the critical battery power in such a way that prolongs the lifetime of the devices. Also its performance is compared with the MTPR protocol and Min-max battery cost routing protocols. The comparative studies between these protocols conveys that the MDR protocol reduces the over dissipation of the power due to heavy traffic. This protocol efficiently operates even in the case of continuous heavy traffic flow and prolongs the life time of the battery.

In the work [6] of Morteze et al., proposed Power aware Source Routing (PSR) protocol for MANET. This is one of the on demand protocols. Like other on demand protocol, it also consists of two processes: Route discovery and route maintenance. Its performance is tested against all the well known on demand routing protocol which conveys that PSR performs better in terms of limited power consumption by the devices in the network. The PSR is efficient than DSR protocol in following manner. In DSR, when the node has packets to be sent it broadcasts the RREQ packets. If the node receiving this RREQ packet is not destination node it again broadcasts the RREQ packets or if it is destination node it sends ACK packet or if the node is aware of the destination node it sends the route information to the source node. In case of PSR, the each node in the network creates link cost and adds it to the route cost. The total cost is stored as Min-cost in the packet header. Only if the forthcoming packet has this Min-cost less than the previous

packet, then it is permitted to be forwarded or broadcasted. Thus PSR protocol saves more amount of power by decreasing the number of packets to be broadcasted in the network.

IV. POWER SAVING BY USING POWER MANAGEMENT TECHNIQUE

MANET is a mesh wireless network in which each node in the network is connected to every other node in the network. Hence failure of any node does not affect the communication of the entire network rather the communication to that particular node is affected. In MANET, every node performs transmission of packets, forwarding the packets, receiving and processing the packets. Thus it experiences three types of states: transmitting state, receiving state and sleeping state. Each state consumes different amount of energy. Transmitting state consumes the most energy assigned to the node as most of its energy is wasted in transmitting the packets and this can be minimized according to the methods discussed in the section.3. Receiving state also consumes energy but less compared to that of the transmitting state. Sleeping state can also be called as dozing state or listening state. During this state it listen the channel but cannot transmit or receive any signal from other node. In some networks, a wakeup is sent in order to wake up the node from the sleeping state.

Power management is a method of saving power in which the node switches between active state and sleeping state to reduce the power consumed and prolong the life of the network. Power management technique is simple if all the nodes are in same clock. In MANET, the nodes enter and leave the network at any time and hence maintaining synchronization between the all the nodes is impossible. MANETS are asynchronous networks. In asynchronous networks the power management is difficult task. The studies related to power management techniques used in the MANETs are seen below.

The first power saving protocol that uses power management technique concentrates on the simple quorum [7] in which all the nodes maintains the same quorum with the same Scheduled Repetition Interval (SRI). Even though this works on asynchronous network, it is not so much effective when the SRI of the nodes varies. Next is the Cyclic Quorum systems proposed by the Jiang *et al.*, in [8] where the nodes have the same SRI with different quorums of their own. Consider a network with the SRI =5 then there are five different quorum subsets possible. The quorum table for this case is given in the Table. 1.

TABLE. 1
Quorum table for SRI =5

Subsets	Position of Beacon period	
q0	0	1
q1	1	2
q2	2	3
q3	3	4
q4	4	0

The slot number given in the table acts as the beacon period and the rest are the normal data period. The node which enters the sleeping selects one of the quorums from the above table.

There is constraint present in this is that the two communicating nodes must select the same quorum or else the communication between them fails.

In the work of Shan-Hung Wu et al., [9], asynchronous cyclic quorum is proposed for clustered MANETs which is the first asymmetric quorum systems. Here the network is divided into clusters and each cluster is assigned a cluster head on its residual power basis. Each network consists of gateway or relay that connects various clusters. Two types of quorums are used: s-quorums, a- quorums. Basic cyclic quorum requires overlapping of awake periods of all nodes for effective communication where as the overlapping awake periods of cluster heads of different clusters is enough for effective inter cluster communication. Even though the cluster head consumes more power this protocol enhances the overall lifetime of the cluster. It prolongs the lifetime of the network as a whole of about 52% when compared to the cyclic quorum protocol.

The neighbor maintenance procedure is grid system instead of the table used in the above methods. Consider the SRI= 9 then the grid is filled row-wise starting from left to right and top to bottom s shown in the Fig.2

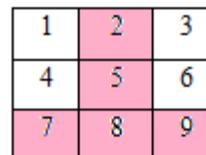


Fig.2 Grid pattern for SRI=9

The shaded portion in the above grid forms the beacon period and the rest forms the normal data period. Here the two nodes communicating have their own repetition pattern interval and different quorum. The transmitting node sends its beacon frame in any one of the above interval that is shaded such that it intersects with the shaded portion of the receiving node which is the beacon period of the receiving node. This in turn increases the probability that transmitting node sends the messages to receiving node when it is awake. This is effective compared to the previous method in the sense that all the nodes need not maintain the same table to communicate with each other. But this also possess a drawback where the SRI must be of the square number or prime number where in most it is preferably to be square to form the grid easier. This limits that a node which has SRI which is not a square cannot communicate efficiently with the other nodes in the network.

Shan Hung Wu et al.,[10] proposed Hyper Quorum Systems (HQS) in which the neighbor maintenance procedure supports any quorum of arbitrary length. Here when the neighbor is discovered, an imaginary plane is constructed. This imaginary plane is of length mod (a, b) where a and b are the SRI length of the two communicating nodes respectively. HQS protocol not only increases the residual power of the network it also increases the probability of neighbor discovery. Thus throughput, packet delivery ratio is also improved. With this protocol, a node entering the network can easily communicate with the rest of the nodes without any change in its quorum structure. Another advantage of using this protocol is controllable delay. This

provides 41% improvement in the power saving compared to the ACQ protocol.

Zi-Tsan Chou et al., [11] proposed OFAA protocol that uses power management technique to save the power. Compared to the previous methods the structure of the beacon interval is changed. This new structure decreases the active time of the node which means decreased duty cycle to reduce the power. The neighbor maintenance procedure is cyclic quorum table. The duty cycle of OFAA protocol is only 50% of the existing protocol. The quorum table is constructed such that it supports SRI of arbitrary length between 3 and 13. However, the nodes with SRI greater than 13 are not possible to communicate with other nodes. Since node with SRI above 13 is a rare case this is effective in terms of reducing the power consumption.

V. CONCLUSION

MANET is the network of devices that communicate with the help of instant infrastructure. Each node is provided with a battery backup. Efficient use of this battery power is essential in order to establish a long term communication between any two nodes in the network. In this paper, number of methods which are used in each category like power saving by using variable transmission power, power saving by using power aware routing protocol and power saving by using power management techniques are seen. This gives a better view on which method can be used depending on the scenario where the MANET is used. One of the methods discussed above can be used depends on the factors such as distance between the two nodes, its delay tolerance, data traffic rate, critical usage of battery power etc, using suitable algorithm not only enhances the life time of the network it makes the communication more effective in terms of throughput, PDR and delay.

REFERENCES

- [1] Jang-Ping Sheu, Kun-Ying Hsieh and Yao-Kun Cheng, "Distributed Transmission Power Control Algorithm for Wireless Sensor Networks", *Journal of Information Science and Engineering*, Vol. 25, No. 2, pp. 1447-1463, Jun 2009.
- [2] C.K Nagpal, Maninder Kaur, Shailender Gupta and Bharat Bhushan, "Impact of Variable Transmission Range on MANET Performance", *International Journal of Ad Hoc, Sensor & Ubiquitous Computing (IJASUC)*, Vol. 2, No. 4, pp. 59-66, Dec 2011.

- [3] Dinesh Ratan Gautam, Sanjeev Sharma and Santosh Sahu, "Enhanced Transmission Power Control Mechanism Based on RSSI for MANET", *International Journal of Computer Applications (0975 – 8887)*, Vol. 28, No. 1, pp. 25-30, Aug 2011.
- [4] Sridhar H.S, Dr. M. Siddappa and Dr.G.C.Bhanu Praka, "Power Aware Routing Protocol for MANETs using Swarm Intelligence", *International Journal of Advanced Research in Computer and Communication Engineering*, Vol. 2, No. 8, pp. 2960-2965, August 2013.
- [5] Dongkyun Kim, JJ Garcia-Luna-Aceves, Katia Obraczka, Juan-Carlos Cano and Pietro Manzoni, "Power-Aware Routing Based on The Energy Drain Rate for Mobile Ad Hoc Networks", Work Supported by the Post-doctoral Fellowship Program of Korea Science & Engineering Foundation (KOSEF), pp. 1-5, Mar 2004.
- [6] Morteza Maleki, Karthik Dantu, and Massoud Pedram, "Power-aware Source Routing Protocol for Mobile Ad Hoc Networks", *International Conference ISLPED'02, Monterey, California, USA, Copyright 2002 ACM 1-58113-475-4/02/0008*, Aug 2002.
- [7] C. Tseng, C.-S. Hsu, and T.-Y. Hsieh, "Power-saving Protocols for IEEE 802.11-based Multi-hop Ad hoc Networks", *IEEE Transaction on Computer Network*, Vol. 43, No. 3, pp. 317–337, Oct 2003.
- [8] Jehn-Ruey Jiang, Yu-Chee Tseng, Chih-Shun Hsu and Ten-Hwang Lai, "Quorum-Based Asynchronous Power-Saving Protocols for IEEE 802.11 Ad Hoc Networks", work supported by the MOE Program for Promoting Academic Excellence of Universities, Grant numbers A-91-H-FA07-1-4 and 89-E-FA04-1-4, pp. 1-8, Jun 2004.
- [9] Shan-Hung Wu, Chung-Min Chen and Ming-Syan Chen, "An Asymmetric Quorum-based Power Saving Protocol for Clustered Ad Hoc Networks", *IEEE Transactions on Mobile Computing*, Vol. 11, No. 4, pp. 1167-1174, Apr 2011.
- [10] Shan-Hung Wu, Ming-Syan Chen and Chung-Min Chen, "Fully Adaptive Power Saving Protocols for Ad Hoc Networks Using the Hyper Quorum System", *IEEE International Conference on Distributed Computing Systems*, pp. 785-792, Oct 2008.
- [11] Zi-Tsan Chou, Yu-Hsiang Lin And Tsang-Ling Sheu, "Asynchronous Power Management Protocols With Minimum Duty Cycle And Maximum Adaptiveness For Multihop Ad Hoc Networks", *IEEE Transactions on Vehicular Technology*, Vol. 62, No. 7, pp. 3361-3314, Sep 2013.

AUTHORS

First Author – A. Sakthi Saranya, PG Scholar, ECE-PG Dept, Sona College of Technology, email: sreedeevisakthisaranya@gmail.com
Second Author – G. Ravi, Assistant Professor, ECE-PG Dept, Sona College of Technology, email: raviraj.govind@gmail.com

Big Data and a Smarter University: A Literature Review

Sameer Hayikader *, Mohd. Toriq Khan bin Mohamad Niyaz Khan **, Abdulrahman Dahlan ***

*sameer797.kader@gmail.com, ** mohdtoriqkhan@hotmail.com, *** arad@iium.edu.com

Department of Information Systems, Kulliyah of Information and Communication Technology,
International Islamic University Malaysia

Abstract- Using big data in a university is ‘the thing’ today since almost all information today is digitalized. Big data ensures better data processing, analysis and sharing, thus increasing productivity and researchers would have a great time doing their researches. A smart university is a university which uses technologies which could increase the productivity of knowledge management. Changing into a smart university is definitely a smart move because it is important to be competitive in a world full of formidable competitors. Research has proven that smart universities such as Caltech University and Northwestern University which are among the top universities in the world has also endeavored into the big data arena.

Index Terms- Data warehouse, big data, smart university, sharing knowledge.

I. INTRODUCTION

A data warehouse is designed to integrate data from various sources to a single platform and structure. Data warehouse is different from other applications it has its own specification and characteristics which make it unique. It provides tools to meet the information needs of the users at all levels, not just for complex data queries, but as well as in term of retrieving a quick, accurate, and often insightful information. A data warehouse is designed so that its users can recognize the information they want and access that information using simple tools [1]. The data warehouse is not only designed to have a single platform, but it also to have more exploring objectives such as summarization and data mining [2]. Data integration means collecting and combining data from various source systems for usage by users. Data integration was limited to transactional systems and their applications. Big data processing needs to be implemented as a data-driven architecture that includes the analysis and design of data processing, which all the data within the enterprise are categorized according to the data type [3]. Data warehouse and big data integration must respond quickly to business needs, balance requirements against implementation options using their technical knowledge, and build the requisite structures and processes. University of Cambridge which ranks number two in the QS top universities ranking is using big data and they are still researching its potentials and sharing their knowledge in this what they called “growing field [20].” Another example among the top university that uses big data is university of Washington. University of

Washington offers education and research in big data. They now have several projects regarding big data such as the AstroDB, Myria, CQMS, Data EcoSystem and SQLShare [21].

II. BACKGROUND

Universities that operate its system based on multiple systems of different data sources that include Oracle, MySQL, SQL server etc. will affect the reliability and the quality of data in term of incomplete data integration. A centralized system means that database and information are centralized and that will make the university work more efficiency [4]. Another problem is that staffs and top managers have to spend much time in business decisions based on limited data from different department. Data warehouse has several benefits once it’s launch as it will enhance business intelligence, cut time consuming , generates ROI profit. And also organizations that have implemented data warehouses and complementary BI systems have generated more revenue and saved more money than organizations that haven’t invested in BI systems and data warehouses [5].

Another advantage of having centralized database is that sharing all information and knowledge can be done much easier and accessed into it in a single location. By having a centralized database looking for the information in database can be faster because the search engine needs to check only a single location rather than multiple locations to get the results. Sharing knowledge and Information can be organized easier in a single location. Centralized database makes adding server to the database site not complicated so that the company will not have to balance the needs of a distributed database [6]. Combine spreadsheets from each department in order to generate a report manually cost time. Process that done manually in universities in order to get a report or approval from various departments or to some analysis from colleagues will take longer time than expected. By implementing a data warehouse will help centralize and gather data and make it available to all team members more effectively [7].

The first smart tertiary education centre in Malaysia is KDU University College. KDU focuses on learning from people and individual experiences. KDU is using a technology called the ‘Grammarly@EDU’ where it facilitates academic writing [18]. Example of an international smart university is University of Michigan, where they would perform full-time research in a faculty laboratory, have weekly luncheon presentations where faculty discuss their research, have short presentations of their summer accomplishments at the conclusion of the program, obtain clinical exposure opportunities in the form of physician shadowing and students will be able to receive a stipend of

\$4400, plus housing [19]. By becoming a smart university, not only the university's ranking will rise, but also other aspects related to the university, such as increased profit, student enrollment, researching abilities and publishing and the university would also be able to share and receive knowledge from other universities [12][16][17].

III. PROBLEM STATEMENTS

- 1) Malaysian universities are still left behind in terms of university world ranking due to several shortcomings including the lack of technology implementation which includes big data and offering big data courses.
- 2) Universities in Malaysia lack the initiatives to implement big data and becoming smart university.

IV. LITERATURE REVIEW

Big data is in many ways an evolution of data warehousing and the business benefits of big data are potentially revolutionary [8]. According to [9], big data was included as a data warehouse modernization. Today we can see that big data has been descended to many fields such as the healthcare, government, e-commerce and universities [22][10]. However, according to [11], data warehousing and big data are actually two separate things; that data warehousing is only architecture to store data while big data is a technology. In the context of this research, as far as a university is concerned, in relation to data warehousing and big data, they can be used to store a huge archive of students', lecturers' and employees' data and that data can be used to be as a reference for future lecturers and employees to attract future students or stakeholders or to look into better ways to teach students which in return, would generate more income for the university. Just like what a research on the Bank of America had done towards its customers on what kind of loan was the most requested by its stakeholders using data mining which is the basis for data warehousing and big data and they have found out that home equity loan was the most requested loan and they acted upon that data and they successfully managed to increase their stakeholders' response rate from 0.7 percent to 7 percent [12]. All of these researches didn't provide the actual feelings of the recipients or stakeholders' feelings towards the implementation of big data into data warehouse into a university environment, which will be the aim of this research besides performance statistics. A smart university is actually defined first by the 'smart' term which according to [13], as a strategic approach to economic development through targeted support to Research and Innovation. While according to [14] & [15], the smart term is actually abbreviation for S, Specific, M is Measurable, A is Achievable, R is Relevant and T is Timely. Proving that big data can bring better achievements to a university can be seen from University of Florida. Its vice president and chief information officer, Elias Eldayrie said that "The processing and analysis of our faculty's research has been greatly increased, meaning their important work in health care, climatology, and other critical areas makes it into the global conversation faster. We have faculty conducting brain injury research. We have faculty

studying how oil spills impact the fisheries along the Gulf of Mexico, and so many more projects of significant state and worldwide impact. Their research in these fields of study can get to the marketplace quicker thanks to the computing abilities we now have in place at UF (University Florida)." Big data had reduced the time needed to process large data queries of 10 million to 100 million records from 27 hours to a mere 3 seconds, allowing the UF faculties to analyze their research more efficiently and share findings with top institutions, as well as the scientific organizations and government agencies sponsoring UF's expansive research portfolio [16]. [17], the world top university of 2014 had also launched a summer school on big data because Caltech University believes that students and postdocs need to master such skills in order to be effective researchers today. Clearly, big data and data warehousing are fields to be explored and mastered to secure a better future not only for business, but even for universities. A university's rank is one of the criteria for a student's choice to study in that particular university [24]. A university's rank is determined by these criteria which include academic reputation, employer reputation, student-to-faculty ratio, citations per faculty and international faculty ratio and international student ratio [23]. Based on all of these researches, there are a lot of benefits in becoming a smart university, such as increased education quality, research output that is by increasing the analysis and understanding of lots of information through the use of big data [22], ranking and performance. To become a smart university, a university should have the required technologies such as a good server, classrooms with technological devices equipped, a special technology that would help the universities functions and having the S.M.A.R.T objectives which includes efficient and reliable employees and efficient standard of procedures (SOP) or processes in order to complete tasks [25] or have a strategic approach to economic development through targeted support to Research and Innovation [13].

V. INITIAL RESEARCH FRAMEWORK

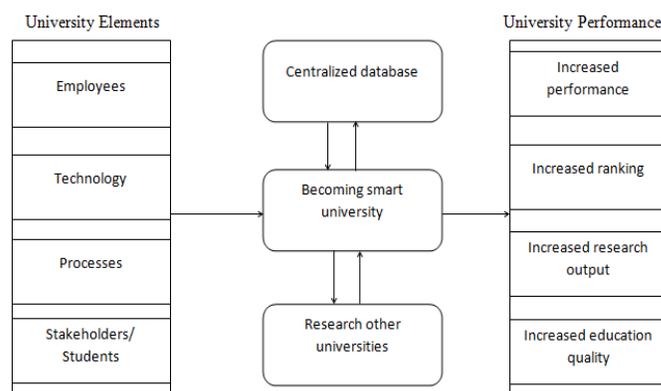


Figure 1. initial research framework.

VI. SHARING KNOWLEDGE IN A SMART UNIVERSITY USING BIG DATA

Knowledge sharing in software enterprise is basically about teams working together to achieve shared objectives. A smart university can make the use of big Data technologies and social

network to share knowledge and experience by making processes, artifacts, and knowledge more explicit and sharable.

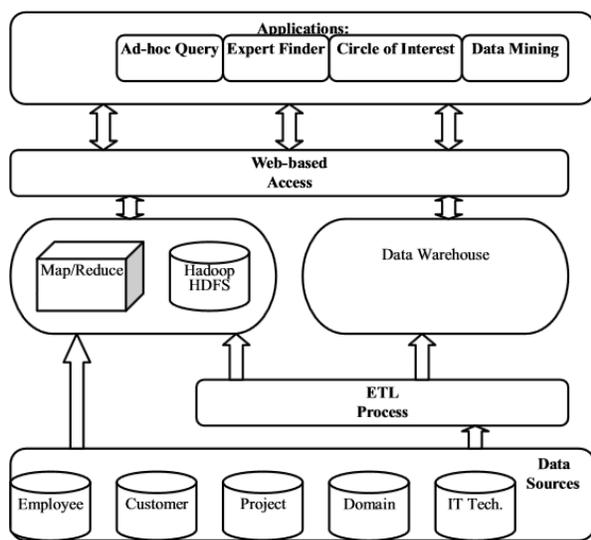


Figure2. A framework of knowledge sharing in software enterprise. [26]

There are three components included In this framework of knowledge sharing which are:

- 1) Data sources: information on employees’ personal information, information on customer with industry characteristics, information on completed project in organization, domain information on software engineering, knowledge on IT Tech. These are operational data sources.
- 2) Hadoop, HDFS and Data warehouse: managing and storing structured knowledge and unstructured knowledge on people, projects, products, and processes.
- 3) Applications: including knowledge artifacts looking up and sharing and mining using Ad-hoc query, Expert finder, Circle of interests and data mining tools.

VII. CONCLUSION AND FUTURE WORK

As a conclusion, the integration of big data into university for a smarter university is definitely something to be looked into as it would provide a better future for both students and the universities employees. Besides increasing profit and the ranking for the university, it would also increase the stakeholders’ satisfaction towards the services of the university. This project will ensure continuous innovation to the university, which may open ways to other innovations for a better university since this integration of big data and data warehouse will provide the capability of storing large amount of data, it will provide easy

access to all data in a centralized database from all departments. As well as to address the importance of using Big data in sharing knowledge. For future work, surveys and analysis towards the implementation of big data and becoming smart university will be investigated to improve university performance.

REFERENCES

- [1] A. Perkins, “Critical Success Factors for Data Warehouse Engineering,” p. 1.
- [2] J. Wang, *Data Warehousing and Mining : Concepts, Methodologies, Tools, and Application*, New York: Information Science reference, 2008.
- [3] K. Krishnan, "Search Data Management," Tech Target, [Online]. Available: <http://searchdatamanagement.techtarget.com/feature/Author-explains-big-data-integration-in-the-data-warehouse>. [Accessed 27 2 2014].
- [4] "Effective Database Management," [Online]. Available: <http://effectivedatabase.com/resources/why-should-you-have-a-centralized-system/>. [Accessed 25 2 2015].
- [5] S. B. Team, "TIBCO spotfire's," 10 August 2011. [Online]. Available: <http://spotfire.tibco.com/blog/?p=7597>. [Accessed 25 Feb 2015].
- [6] M. McMahon, "wise GEEK," 10 Feb 2015. [Online]. Available: www.wisegeek.com/what-is-a-centralized-database.htm. [Accessed 25 Feb 2015].
- [7] Editor, "TechAdvisory," 2014. [Online]. Available: <http://www.techadvisory.org/2014/08/does-your-company-need-a-data-warehouse/>. [Accessed 25 Feb 2015].
- [8] Oracle, "Oracle Database 12c for Data Warehousing and Big Data", Oracle White Paper, 2014.
- [9] IBM, "Data Warehouse Modernization," 2015. [Online]. Available: <http://www01.ibm.com/software/data/bigdata/use-cases/data-warehouse.html>. [Accessed 24 Feb 2015].
- [10] Chen, Hsinchun, Chiang, Roger H.L. & Storey, Veda C. "Business Intelligence and Analytics: from Big Data to Big Impact," MIS Quarterly, 2012.
- [11] Inmon, Bill, "Big Data Implementation vs. Data Warehousing," 2013. [Online]. Available: <http://www.b-eye-network.com/view/17017>. [Accessed 24 Feb 2015].
- [12] Berry, Michael J.A. & Linoff, Gordon S., "Data Mining Techniques for Marketing , Sales and Customer Relationship Management. A Case Study in Business Data Mining". (Second Edition, pp. 22-28), 2004. [Online] Available: Google Book. [Accessed 24 Feb 2015].
- [13] Kempton, Louise, Goddard, John Edwards, Barbara Hegyi, Fatime & Perez, Susana-Elena, "Universities and Smart Specialisation. Background to 'Smart Specialisation' (pp. 4)," European Commision Joint Research Centre, 2013.
- [14] UMass Dartmouth, "Creating S.M.A.R.T Goals," 2015. [Online]. Available: <http://www.umassd.edu/fycm/goalsetting/resources/smartgoals/>. [Accessed 24 Feb 2015].
- [15] Wake Forest University, "SMART Goal Setting Instructions," 2012. [Online]. Office of Personal & Career Development. [Accessed 24 Feb 2015].

- [16] University of Florida, "University of Florida receives \$500,000 'Big Data' boost from IBM," 2014. [Online]. Available: <http://news.ufl.edu/archive/2014/09/university-of-florida-receives-500000-big-data-boost-from-ibm.html>. [Accessed 24 Feb 2015].
- [17] Caltech University, "Big Data Summer School Is in Session—Virtually," 2014. [Online]. Available: <http://www.caltech.edu/news/big-data-summer-school-session-virtually-43622>. [Accessed 24 Feb 2015].
- [18] KDU University College, "Student Entry", 2015, [Online]. Available: <http://www.kdu.edu.my/teaching-learning/student-entry>. [Accessed 10 March 2015].
- [19] University of Michigan, "UM-SMART Undergrad Summer Program, Summer at Michigan for Undergraduate Research Training UM-SMART," Available: <http://medicine.umich.edu/medschool/education/mdphd-program/um-smart-undergrad-summer-program>. [Accessed 14 March 2015].
- [20] University of Cambridge, "Cambridge Big Data," [Online]. Available: <http://www.bigdata.cam.ac.uk/>
- [21] University of Washington, "Big Data Research and Education" [Online]. Available: <http://www.cs.washington.edu/research/bigdata>
- [22] Shaw, Jonathan, "Why Big Data is a Big Deal," [Online]. Available: <http://harvardmagazine.com/2014/03/why-big-data-is-a-big-deal>
- [23] QS Top Universities, "QS World Universities Rankings: Methodology," [Online]. Available: <http://www.topuniversities.com/university-rankings-articles/world-university-rankings/qs-world-university-rankings-methodology>
- [24] National Union of Students (NUS), "NUS Student Experience Report," (pp. 3). Student Experience Report, 2008.
- [25] Wayne State University, "S.M.A.R.T Objectives," [Online]. Available: <http://hr.wayne.edu/leads/phase1/smart-objectives.php>
- [26] W. I. LIU, "Framework of sharing knowledge in software organization using big data," *IEEE explore*, p. 271.

AUTHORS

First Author – Sameer Hayikader, Master of Information Technology, Department of Information Systems, Kulliyah of Information and Communication Technology, International Islamic University Malaysia and sameer797.kader@gmail.com.
Second Author – Mohd Toriq Khan Bin Mohamad Nyiaz Khan, Master of Information Technology, Department of Information Systems, Kulliyah of Information and Communication Technology, International Islamic University Malaysia and mohdtoriqkhan@hotmail.com.
Third Author – Abdulrahman Dahlan, Lecturer and Senior Academic Fellow, Department of Information Systems, Kulliyah of Information and Communication Technology, International Islamic University Malaysia and arad@iiu.edu.com.

The Linkage between Training and Development and Co-Worker Support towards Employee Engagement in Hotel Industry

Pei-Yew Lai, Jee-Sin Lee, Yu-Xiang Lim, Ray-Gin Yeoh and Farhana Hanim Mohsin

Universiti Tunku Abdul Rahman

Abstract- In order to motivate employees to be more engaged at work, there is a need to further examine the work variables that enable such. This study is carried out to identify the factors that affect employee engagement; that is the relationship between training and development and co-workers support towards employee engagement. Data were collected through printed and online questionnaire and distributed to 400 respondents among hotel employees. Data were then analyzed using Statistical Analysis System (SAS) program to conduct descriptive analysis, reliability test, Pearson Correlation and Multiple Linear Regression to interpret the collected data. The findings showed that co-workers support bring the most significant relationship towards employee engagement in hotel industry. This result is supported by previous studies and several suggested recommendation have also been discussed.

Index Terms- training and development, co-worker support, employee engagement

I. INTRODUCTION

Employee engagement is an important key element in ensuring the successfulness of an organization. Hence, it is no surprise that engaged employees in 21st century has become a hot topic of discussion in corporate circles (Siddhanta & Roy, 2010). According to Bersin (2014), 78 per cent of business leaders rated retention and engagement as important. He believes that any businesses which able to engaging its people and make employees love their existing work will be able to gain competitive differentiator within the business.

According to Rothmann and Rothmann (2010), employee engagement can affect employees' mind set with regard to their personal initiative and learning. In addition, they also figured out that employee engagement brings lots of positive outcomes to the organizations such as motivation, commitment, low turnover rate and others. Furthermore, according to Gallup (2004), they categorized employee engagement into three different categories. Engaged employees are the type of employees whom will feel passion on their job and willing to work hard. In contrast, the non-engaged employees are mostly unwilling to put extra or more effort on their job by doing the jobs that already arranged for them. The third type is actively disengaged employees.

Generally, employees' knowledge, skills and abilities need to keep current to match with the requirement of the job.

Hence, training and development program are essential to ensure the employees' competencies are updated. According to Aguinis and Kraiger (2009), training and development activities will bring positive effects toward organization and their personal goal. Moreover, better training and development may increase the confidence and self-efficacy among employees to perform well in the job (Wang, 2005). Managers can promote high level of employee engagement by giving appropriate training and development to the employees.

On another note, employees work as a team had become one of the common features in modern organizations (Jungert, 2012). Members in team able to work more independently among themselves; correspond and organize each and everyone's actions in order for them to reach their goals. One of the effects that can be seen through team and coworkers support is in reducing the traditional hierarchical relationship between employers and employees through the work collaboration. Moreover, developing friendship at workplace among those employees and coworkers strengthen the engagement of the employees (Tews et al, 2013).

In the foreground, among the Southeast Asian countries, Malaysia is one of the lowest employee engagement levels over the past five year (2013-2009). In general, Southeast Asian countries have achieved a high employee engagement level over the past five year, as Malaysia has yet to achieve in terms of employee engagement if compared with the neighborhood countries. In addition, Malaysia experienced a bad moment in 2012, as the percentage of engagement drops to 60%, which the research speculate this attributed to the uncertain political and economic environment leading up to the 2013 election. But the report stated that, Malaysia will have a better employee engagement scores in the future. Undeniably, employee engagement has been a research platform for the researcher to explore and eventually this may lead engagement to have better recognition among the corporate organization (Andrew & Sofian, 2012).

Given these points, the main purpose of this study is to examine the work variables that affect engagement among employees, that is to identify the relationship between (i) training and development and (ii) co-workers support; toward employee engagement.

II. LITERATURE REVIEW

EMPLOYEE ENGAGEMENT

Firstly, engagement in the work field was conceptualized by the author Kahn (1990). He defined

engagement as “the harnessing of organization members engage themselves to their roles; in engagement, people employ and express themselves physically, cognitively, and emotionally during role performance” (p. 694). In similar vein, the term engagement can be defined as an “individual’s involvement and satisfaction, as well as enthusiasm for work” (Harter, Schmidt, & Hayes, 2002, p. 269). Similarly, Corporate Leadership Council (2004) notified that employee engagement as “the extent to which employees commit to something or someone in their organization, how hard they work, and how long they stay as a result of that commitment” (pp. 5).

In addition, in general, the underlying concept of employee engagement can be categorized into three dimensions. First, Rothbard (2001) added the concept idea into two components, such as attention and absorption. The attention can be illustrated as cognitive availability and the statistic that every single individual may spends to think about the role. Besides that, absorption can be identified as engrossed in a role which intensity of one person focuses in a role. Secondly, another concept of engagement was led by burnout researchers, Maslach and Leiter (1997) and Maslach et al. (2001), who conceptualized engagement as the opposite of or the positive contract to the three burnout dimensions: cynicism, exhaustion, and sense of inefficacy (Gonzalez-Roma et al., 2006; Shuck, 2010). Furthermore, Schaufeli et al., (2002) provided a third approach for work engagement, a different perspective and view to the engagement-burnout continuum theory. According to this, engagement can be defined as a “positive, fulfilling, work related state of mind that is characterized by vigor, dedication, and absorption” (Schaufeli et al., 2002, p. 74). Vigor can be categorized by mental resilience and high level of liveliness when carry out the duty or working role, hence this may help to increase the willingness of subordinates towards their work task. Moreover they will become more persistence when facing some ongoing difficulties during the progress (Salanova & Schaufeli, 2008). Dedication, the next element, refers to a strong recognition with a work task and is written off as by a sense of importance, motivation, encouragement, dedication, enthusiastic, and also a sense of self-importance and challenge. Lastly, absorption can be described as characterized by being completely intense or focus particularly in their job scope, whereby time constraint and facing numerous difficulties with unfasten themselves away from work (Laura, 2010).

TRAINING AND DEVELOPMENT

Rothwell & Sredl (1992) defined employee training as a short-term learning intervention voluntary to build or enhance a match between current job requirements and single individual knowledge, skills, and attitudes. Furthermore, they further stated that training helps people to meet minimally acceptable job requirements or refine, upgrade, and improve what they do. Chen (1995) defined employee training as method used to transfer skills, knowledge, and work attitude from the experienced craftsman. Nadler & Nadler (1989) defined employee training as learning, provided by employers to employees that are related to their present jobs. Training is primary concentrate on evaluating, assuring, and helping develop, through planned learning, the key ability that allow single individuals to perform their current work role.

Truelove (1992) further defines development as a path whereby an individual learns from occurrence will be more valuable. The objective is to lend a hand to public to utilize the skills and knowledge that provided by tutoring and exercising, not only for their present career or job as well as future career. Development also reflects some concepts e.g. greater maturity, development of emotion and increase self-assurance.

CO-WORKER SUPPORT

Iverson (1999) defined co-worker support as “the degree of consideration individuals receive from members of their social network” (p. 402). Furthermore, co-worker can be illustrated as sharing knowledge among one another as well as providing encouragement and support (Zhou & George, 2011). In addition, co-worker support can be further elaborated as social support given towards the subordinates by coworker in the working field (Wright, 2009). Poon (2011) study stated that co-worker provided a belief towards social supports. Social support is a significant development tools to enhance proper employee engagement in social organization (Ng & Sorensen, 2008). As the social support can be categorized into four components, such as instrumental support (e.g assist other with job task), emotional support (e.g provide support), informational support and appraisal support (Langford et al., 1997).

Maslach et al. (2001) and Saks (2006) have confirmed that perceived organizational support and justice are important in employee engagement. In addition, Arora and Kamalanabhan (2010) stated that employee that gain fully support from the employer or co-worker is likely to experience more psychological support in their working environment.

TRAINING AND DEVELOPMENT, CO-WORKER SUPPORT AND EMPLOYEE ENGAGEMENT

According to Salminen et al., (2014), Job Demands-Resources (JD-R) model is the association between job resources, optimism and work engagement. This model can be used to identify possible linkage between training and development and co-worker support and employee engagement. The JD-R model furthermore clarify that the linkage connecting task resources and job demand is significant in judge the fundamental in developing employee engagement (Bakker et al., 2006). The model signifies that job resources will create more influence on employee engagement whenever the demands of jobs are consider high (Bakker et al., 2006). According to Salminen et al., (2014), the basis of JD-R model is evoke two different psychological processes on job demands and resources, which are job strain and motivation. Job resources may be encourage and impel and enhance in individual right through maintain, gathering and amassing of resources (Hobfoll, 1989). The fact was Job resources refer to job appearance that is capable in the fostering of personal development, achievement of job mission or goal (Bakker& Demerouti, 2007).

Malik et al. (2013) stated that training and development is considered as a key element to raising employee engagement. They further noted that the improvement of fresh skills and knowledge will ultimately apply into their job performance to enhance employee engagement. In similar vein, Sahinidis & Bouris (2008) proved that when employees perceived that training and development is effective, it shows a strongly

positive relationship with motivation, job commitment and job satisfaction. In the light of JD-R model, training and development can be regarded as job resources, in which the ones provided by the organizations to employees to stimulate learning and development.

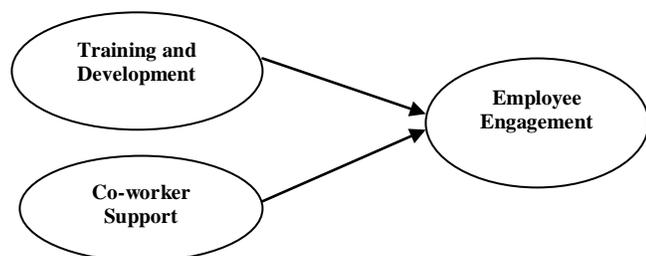
On another note, Wright (2009) highly believed that an individual which highly engaged with the companion of co-worker, will continued engaged themselves in work field. Kahn (1990) also mentioned that individuals who are supportive among each other in the organizations are able to take risks and challenges even though negative consequences might be happened. He also further mentioned that employees would feel safer once they have the support from their team members. Thus, these supportive actions from co-workers will foster the employees' willingness to engage themselves fully in the organizations. Similarly, like training and development, co-worker support is also categorized as job resources. Job resources might be discovered according to the point of corporate (e.g., job opportunities, increment, earnings), the organization of the work (role clarity) in interpersonal and (supervisor and coworker support) (Bakker, et al., 2007).

Co-worker support and employee engagement can also be explained by Social Exchange Theory (SET). Saks et al (2006) concluded that SET provides an essential foundation to enlighten the reasons for employees in choosing to turn into engagement in their employment. When employees are given those supports from coworkers in an organization and received adequate training and development, they feel more obliged and willing to engage themselves. Similarly to the definition of Kahn (1990) of engagement, employees would feel obliged to bring themselves more deeply as the repayment for the coworkers support and training and development actions.

As conclusion, employees who are able to enhance their knowledge and skills through training are most likely to be fully engage and adaptive to their work field, because of the satisfaction on completed the new assignment and increase their future employability (Lockwood, 2007). Similarly for co-worker support, an affiliation that existed among team and coworkers support toward employee engagement.

CONCEPTUAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

Figure 1: The proposed Conceptual Framework for the Study



III. RESEARCH METHODOLOGY

SAMPLING AND DATA COLLECTION

Data were collected from a convenience sample of 400 employees working at three to five stars hotels in Penang, Malaysia. Questionnaires were distributed to targeted respondents through both physical conduct and online survey. Self-administered questionnaire is being chosen and carried out in this research. The close-ended question were designed based on the Likert scale method which enable respondents to choose the closest answer to their viewpoint by given specific and limited- alternative responses. A total of 36 items were developed in the questionnaire. The questions are adopted from various sources of previous research papers conducted by other research and some modifications were made in order to fit with research objectives. The questionnaire was divided into three categories. Part A consists of six questions to ask about demographic information of the respondents, while Part B is about factors of training and development and co-workers support which consist of 20 questions. Part C is about the employee engagement which consists of ten questions.

STATISTICAL ANALYSIS

The collected data was used for calculating the average, percentage and the distribution of frequency. Percentage of tables and graphs is used to describe the analysis. Age, gender, education level etc. also had been tested in this research study.

Reliability test was also conducted, in which a coefficient which known as Cronbach's alpha used to point out how excellent the independent variables and dependent variable positively or negatively correlated to one another. The nearer the Cronbach's alpha is to the digit 1, the advanced the reliability between the independent and dependent variables. The strength of the linear relationship between independent and dependent variables is measured with the use of the technique of Pearson's Correlation. The numbers consisted in the Pearson's Correlation which ranges from -1.00 to +1.00 representing an association between the variables.

Furthermore, Multiple Linear Regression (MLR) is a method that used the test whether there is a relationship among the independent and dependent variables. It used in the direction of justify or explain the independent variables (training and development, coworker support) are having a significant variation towards the dependent variable (employee engagement). This technique is to be chosen since it allows all the simultaneous studies of the independent variables interval with one single dependent variable (Ghani & Ahmad, 2011).

DATA ANALYSIS

DESCRIPTIVE ANALYSIS

A total of six questions in Section A were asked with regards of demographic information of respondents The demographic information questions are included gender, age group, education level, stars rating of hotels, working experience and employment status.

For gender, 47.5 percent is male respondents and 52.5 percent is female respondents. Majority of the respondents are in the range of age between 20 to 29 years old, which is 58.25 percent. The second largest percentage is for age group of 30 to 39 years old, which is 26.25 percent. The eldest respondents are minority participated in the research which is 40 to 49 years old

and 50 or older years old. The percentage is 9.50 percent and 4.00 percent respectively.

For education level, most of the respondents are high school graduate, which is 36.00 percent. The second rank is the respondents from college graduate with 31.25 percent. Followed is Bachelor graduate which is 26.50 percent. Master Degree and other education level is occupied the minority, which are 3.00 percent and 2.75 percent.

For hotel star ratings, majority of respondents are working in five stars hotel, which is 62.50 percent. 32.50 percent and five percent are working in four stars and three stars hotels respectively.

For the demographic information of working experience, most of the respondents are working less than one year, which are 36.25 percent. 32.00 percent respondents working more than one year but less than two years. 25 percent are working for 2 years but less than three years and 10 percent of respondents are working more than four years.

Lastly for employment status, majority of respondents are full time employees. There are 89.25 percent for full time and part time employees are 10.75 percent.

RELIABILITY TEST

Based on the result that we gained through SAS software, the highest independent variable was coworker support relationship which standing at the point of 0.913. This variable shows that we gained a very good reliability result. In addition, the second of Cronbach's Alpha shows that employee engagement which gained a 0.867, this also construct as a good reliability test. Lastly, the training and development figure show that we managed to approach 0.843. As a result, the variable also indicates as a good reliable test. All the independent and dependent variable were managed to achieve the result that more than 0.8. Table 2 summarizes the result.

Table 2: Reliability Test Value for Independent and Dependent Variables

Dimension	No of Items	Cronbach's Alpha
Training and Development	10	0.843
Co-worker Support	10	0.913
Employee Engagement	10	0.867

PEARSON ANALYSIS

Table 3 below shows the correlation coefficient between training and development and employee engagement is 0.843746 with a p-value of less than 0.001 (<0.001). It shows that training and development have a strong positive relationship with employee engagement. Thus, conclusion of well-established training and development will have higher engagement among employees.

Table 3 below shows the correlation coefficient between coworkers support and employee engagement. From the table, the Cronbach's coefficient alpha is 0.912552 with a p-value that less than 0.001 (<0.001). It also has a strong relationship between coworker support and employee engagement. Thus, we may

conclude that coworkers support will enhance the engagement of the employees.

Table 3: Correlation between Independent and Dependent Variables

Employee Engagement	Training and Development		Co-worker Support
	Pearson Correlation	0.84374	0.912552
Sig. (2 tailed)	0.001	0.001	
N	400	400	

MULTIPLE LINEAR REGRESSION ANALYSIS

Training and Development (<0.001) and Coworkers support (<0.001) are all significantly affecting employee engagement.. This is because all the p-value are less than 0.001 (<0.001) which are too small that can be determined. The hypotheses for this research study are support by the result above.

In addition, the research study also had shown the standardized coefficients Beta value. This value is used to test each of the independent variable (training and development coworkers' support) in affecting the dependent variable (employee engagement). Among these two independent variables, coworkers support ($\beta=0.3629$) is the most significant factors in affecting the engagement of employees. Whereas, training and development show a lower beta that value than the other independent variable ($\beta=0.3578$).

Table 4: Analysis of Variance

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	42.84751	21.42376	153.82	<.0001
Error	397	55.29409	0.13928		
Corrected Total	399	98.14160			

Table 5: Model of Summary of R Square

Root MSE	0.37320	R-Square	0.4366
Dependent Mean	3.78600	Adjusted R-Square	0.4338
Coefficient Variable	9.85743		

Based on Table 5, R square shows the percentage of the independent variables to illuminate dependent variable's variations. Independent variables (training and development and co-worker support) can explain 43.66% of the variations in dependent variable (employee engagement) in this study. Nevertheless, 56.34% is left unexplained in this research which means other important additional variables in explaining employee engagement that have not been considered in this research.

IV. DISCUSSION AND IMPLICATIONS

Based on the findings in this research, the results show that employee engagement has positive relationships with the two independent variables which are training and development and co-workers relationship. Besides that, all the two variables namely; training and development and co-workers relationship have shown significant relationship with employee engagement.

For training and development, it is therefore sufficient to mention that employees need more training and development to strengthen and promote engagement among employees. - Managers and HR practitioners need to create a good training and development system for their employee. This is because in the study, a significant number of respondents ranked a high vote for the training and development of their organizations. This already prove the importance of training and development to the employee within the organization therefore, managers or employers need to consider designed more effective training and development program for employees. Several studies also support the notion that by providing necessary of training and development to the subordinates it will bring benefits to their organization. Training and development is one of the effectiveness of human resource policies in any organization. As it is known, human resource (workforce) forms an important asset to an organization and when treated well as treasure, it makes up the most vital competitive advantage for any firm.

The second variable is co-workers relationship. With a good co-workers relationship it may help to develop both the individual and organization. Therefore, it is worth recommending to managers and employees to pay more attention on team and co-workers relationship. Several studies also support the notion that good co-worker relationship will lead the organization to a better stage.

For managers, it is therefore important to put in place training and development programs and other learning activities for employees to familiarize with the organizations. This is possible through a series of employee empowerment and involvement to prepare them for the future. Employees in this case will feel appreciated and engaged and that their efforts and presence in the organization is needed. This will enable the creation of new talents within the workforce hence increasing effectiveness and engagement of employees.

In conclusion, the results for both of the independent variables (training and development and, coworker support) also getting the significant positive relationship with employees engagement. These two independent variables are able to enhance the employee engagement in hotel industry. Thus, the result generated in our research can use to guide for future researcher who are willing to figure out the factors will significantly influence to the employees" engagement in hotel industry.

REFERENCES

[1] Adams, G. A., King, L. A., King, D. W. (1996). Relationships of job and family involvement, family social support, and work-family conflict with job and life satisfaction. *Journal of Applied Psychology*, 81 (4), 411-420.
[2] Adams, G. A., King, L. A., and King, D. W. (1996). Relationship of job and family involvement family social support and work-family conflict with job and life satisfaction. *Journal of Applied Psychology*, 81, 411-422.

[3] Adnan Rasheed, Sanam Khan, Dr Muhammad Ramzan (2013). Antecedents and Consequences Of Employee Engagement: The Case of Pakistan. *Journal of Business Studies Quarterly*, Vol. 4. No.4
[4] Aguinis, H., & Kraiger, K. (2009). Benefits of training and development for individuals and teams, organizations, and society. *Annual review of psychology*, 60, 451-474.
[5] Akwasi Opoku-Dakwa, Perceived Impacts and Employees Engagement in Corporate Volunteering: An Interactionist Perspective, Retrieved from <http://www.ivey.uwo.ca/cmsmedia/439298/Opoku-Dakwa-manuscript.pdf>
[6] Alan M. Saks, (2006). "Antecedents and Consequences of Employee Engagement". *Journal of Managerial Psychology*, Vol. 21, Iss: 7, pp. 600619
[7] Amirtharaj, S, M, D., Kalist, S., and Vanathi, V. (2011). HR Concepts in Hotel Industry towards Employee Training and Development. *International Journal of Human Resource Management and Research*. Vol.1, Issue.1 (2011) 44-56.
[8] Amolo, H., Anyanwu, R., & Anozie, C. (2013). Full Length Review Article. *International Journal of Development Research*. Vol. 1, Issue, 7, pp.058060, November, 2011
[9] Anand, P. (2011). Case study of employee engagement and performance appraisal: ITC Maurya. *Review of Management*, Vol. 1, No.2
[10] Andrew, C.O & Sofian, S. (2012). Individual factors and work outcomes of employee engagement.
[11] Aon, H. (2014). 2014 Trends in Global Employee Engagement. Consulting Performance, Reward & Talent. Retrieved from <http://www.aon.com/attachments/human-capital-consulting/2014-trends-inglobal-employee-engagement-report.pdf>
[12] Arora, P & Kamalanabhan, T.J. (2012). Linking of supervisor and co-worker support to employee innovative behaviour at work: role of physiological condition
[13] Aryee, S and X.C. Zhen (2006). "Leader-member Exchange in a Chinese Context: Antecedents, the Mediating Role of Psychological Empowerment and Outcomes" *Journal of Business Research* Vol.59, No.7, pp.793-801. Asia rooms.com. (2014). Malaysia Hotels. Retrieved June 29th, 2014 from http://www.asiarooms.com/en/malaysia/index.html?curr=MYR&pv=GOO_G_02661MYc&WT.srch=1&gclid=CjgKEAjw8r6dBRDZprbmdPi90sSJA B2U6dRKC 9wheY8z8cLKwbAWhf4ejWbCFvImCodFnyFxcvQPD_BwE
[14] Bakar, A. H. A., Ramli, M., Jamaludin, M., & Adamy, A. (2010). Employee Engagement -Engaging the 21st Century Workforce. *Asian Journal of Management Research*. ISSN 2229 – 3795.
[15] Bakker, A. B., Demerouti, E., & Euwema, M. C. (2005). Job resources buffer the impact of job demands on burnout. *Journal of Occupational Health Psychology*, 10, 170 –180.
[16] Bakker, A. B., Demerouti, E., Taris, T., Schaufeli, W. B., & Schreurs, P. (2006). A multi-group analysis of the job demands-resources model in four homecare organizations. *International Journal of Stress Management*, 10, 16-38.
[17] Barlett, P. (2011). Employee engagement forum.
[18] Barreiro, P. L., & Albandoz, J. P. (2001). Population and sample. Sampling techniques. *Management mathematics for European schools*.
[19] Baumruk, R. (2004) „the missing link: the role of employee engagement in business successes, *Work span*, Vol 47, pp48-52. Beehr, T. A., Jex, S. M., Stacy, B. A., & Murray, M. A. (2000). Work Stressors and coworker support as predictors of individual strain and job performance. *Journal of Organizational Behavior*, No. 21, pp. 391-405
[20] Bell, E. and Bryman, A., 'The ethics of management research: an exploratory content analysis', *British Journal of Management*, 18, 2007, pp. 63-77.
[21] Bersin. (2013). Predictions for 2014: Building A Strong Talent Pipeline for The Global Economic Recovery — Time for Innovative and Integrated Talent and HR Strategies. Deloitte Research Report. Retrieved from <http://www.cdmn.ca/wp-content/uploads/2014/02/C-inetpub-wwrootProd-uploadedFiles-122013PSGP.pdf>
[22] Bersin, J. (2014). It's Time To Rethink The 'Employee Engagement' Issue. *Forbes*. Retrieved from <http://www.forbes.com/sites/joshbersin/2014/04/10/itstime-to-rethink-the-employee-engagement-issue/>
[23] Bokuniewicz, J. F. (2013). Social Networking for Employee Engagement in the Hospitality Industry (Doctoral dissertation, Drexel University).

- [24] Bramham, J. (1994). *Human Resources Planning*. 2nd edition, London: IPD Chapter 3
- [25] Brum, S. (2007). What impact does training have on employee commitment and employee turnover. In Schmidt Labour Research Centre Seminar Research Series (pp. 1-13).
- [26] Brynard, P.A. & Hanekom, S.X. (2006). *Introduction to research in management related fields*, 2nd Ed. Pretoria: Van Schaik.
- [27] Cantoni, L., Kalbaska, N., & Inversini, A. (2009). E-learning in tourism and hospitality: A map. *Journal of Hospitality, Leisure, Sport and Tourism Education*, 8(2), 148-156.
- [28] Cartwright, R. (2008). *Implementing a Training and Development Strategy*. Retrieved from http://www.khuisf.ac.ir/DorsaPax/userfiles/file/motaleat/Capstone%20ExpressExec_11_08%20Implementing%20a%20Training%20and%20Development%20Strategy.pdf
- [29] Castellano, W. G. (2001). *A new framework of employee engagement*. New Jersey.
- [30] Chan, S. Y., Chan, Y. F., Khoo, Y. M., Loh, P. Y., & Wong, W. J. (2012). A study of employee satisfaction and its effect towards loyalty in hotel industry.
- [31] Chen, S.H. (1995, May/June). Planning and development of employer-sponsored training services system. *Employment and Training*. 5-10.
- [32] Civil Service Branch. (1995). *HUMAN RESOURCE MANAGEMENT*. Retrieved from <http://www.csb.gov.hk/english/publication/files/e-hrmguide.pdf>
- [33] Cook, J., & Wall, T. (1980). New work attitudes measures of trust, organizational commitment and personal need non-fulfilment. *Journal of occupation psychological*. 53, 29-52.
- [34] Corporate Leadership Council (2004). *Driving performance and retention through employee engagement*.
- [35] Council, C. L. (2004). *Driving performance and retention through employee engagement*. Washington, DC: Corporate Executive Board.
- [36] Creswell, John W. (2009). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 3rd Edition. Los Angeles: Sage Publications, Inc.
- [37] Cropanzano, R. & Mitchell, M. S. (2005). Social Exchange Theory: An Interdisciplinary Review. *Journal of Management*, Vol. 31, 874-900
- [38] Czarnowsky, M. (2008). *Learning's role in employee engagement: An ASTD research study*. Alexandria, VA: American Society for Training and Development.
- [39] David MacLeod, Nita Clarke (2014). *Engaging For Success: Enhancing Performance Through Employee Engagement*, Retrieved from <http://gsamarketing.co.uk/wp-content/uploads/2014/05/MacLeod-Report-onemployee-engagement.pdf>
- [40] Department of Statistics Malaysia. (2011). *Service Statistics: Economic Census 2011 Accommodation Services*.
- [41] Department of Statistics Malaysia. (2013). *National Accounts GDP BY STATE 2005 – 2012*.
- [42] Department of Statistics Malaysia. (2014). *Labor Force Statistics Malaysia*, April 2014.
- [43] Dessler, G. (2007). *Human Resource Management*. New Delhi: Prentice Hall of India Private Limited
- [44] Dickson, A.D. (2013). *Fostering employee engagement. A critical competency for hospitality industry manager*.
- [45] Difeng Yu (2013). *A Case Study of Employee Engagement in AkzoNobel Corporate HR*
- [46] Dr. J. Anitha (2012). *Antecedents of Employee Engagement and Their Impact on Employee Performance*, Retrieved from <http://www.grgsms.com/wpcontent/uploads/2013/11/wp1.pdf>
- [47] Dr. Padmakumar Ram, Dr. Gantasala V. Prabhakar (2011). *The Role of Employee Engagement in Work-related Outcomes*. *Interdisciplinary Journal of Research in Business*, Vol. 1, Issue. 3, pp. 47-61
- [48] Edmondson, A (1999). *Psychological Safety and Learning Behavior in Work Teams*. *Administrative Science Quarterly*, No. 44, 350-383
- [49] Eisenberger, R., Armeli, S., Rexwinkel, B., Lynch, P. D., & Rhoades, L. (2001). Reciprocation of Perceived Organizational Support. *Journal of Applied Psychology*, No. 86, 42-51
- [50] Employment Department, 1994, *Training Statistics*, London: HMSO, p.11.
- [51] Employee Development Systems, Inc. (2010). *How to Improve Employee Performance, Professionalism and Effectiveness. Make the Most of the Generational Mix and Lead the Charge in Successful Employee Development*. Retrieved from http://www.employeedevelopment.com/media/Pdfs/GenMixSuccess_WhitePaper.pdf
- [52] Etzion, D. (1984) *Moderating of social support on the stress of burnout – relationship*.
- [53] Fisher, C. D. (1985). *Social support and adjustment to work: A longitudinal study*. *Journal of Management*, 11, 39-53.
- [54] Forte, R., 1982, “ How I see the personnel function”, *Personnel Management*, Vol14, No.8, pp.32-5.
- [55] Gebauer, J., Lowman, D., & Gordon, J. (2008). *Closing the engagement gap: How great companies unlock employee potential for superior results*. New York, NY: Penguin.
- [56] Gibbons, J. (2006). *Employee Engagement: a Review of Current Research and Its Implications*. Retrieved from <http://www.conference-board.org>
- [57] Greengard, S. (1995). *Leveraging a low-wage work force*. *Personnel Journal*, 74, 90-98.
- [58] Groenewald, D. (2010). Chapter 5: *Research Design and Methodology of the Study*. Retrieved from <http://upetd.up.ac.za/thesis/available/etd-04282010085324/unrestricted/0>
- [59] Gronroos, C. (1990), *Service Management and Marketing*, Lexington Books, Lexington, MA.
- [60] Hair Jr. Jf, Bush RP, Ortinau DJ. (2003). *Marketing Research: Within Changing Information Environment*. New York (NY): McGraw-Hill/Irwin
- [61] Hakanen, J.J., & Roodt, G. (2010). Using the job demands-resources model to predict engagement: Analyzing a conceptual model. In A.B. Bakker, & M.P. Leiter, (Eds.). *Work Engagement, A Handbook of Essential Theory and Research* (pp.85–101). Great Britain: Psychology Press.
- [62] Hall, S.S.J., 1990 *Quality Assurance in the Hospitality Industry*, Wisconsin: Quality Press, ch.15.
- [63] Harter, J. K., Schmidt, F. L., & Hayes, T. L. (2002). Business-unit-level relationship between employee satisfaction, employee engagement, and business outcomes: A meta-analysis. *Journal of Applied Psychology*, 87(2), 268-279.
- [64] Hasset, J. (1992, September). *Simplifying ROI*. *Training*. 53-57.
- [65] Hinkin, T. T., & Tracey, J. B. (2000). *The cost of turnover*. *Cornell Hotel and Restaurant Administration Quarterly*, 41, 14-21.
- [66] Hinson Langford, C., Bowsher, J., Maloney J., & Lillis, P. (1997). *Social support: A conceptual analysis*. *Journal of advanced nursing*.
- [67] Hobfoll, S. E. (1989). *Conservation of resources: A new attempt at conceptualizing stress*. *American Psychologist*, 44, 513-524.
- [68] Hobman, E. V., Bordia, P., & Gallois, C. (2004). *Perceived dissimilarity and work group involvement: The moderating effects of group openness to diversity*. *Group and Organization Management*, 29, 560–587.
- [69] Hodson, R. (1997). *Group relations at work: Solidarity, conflict, and relations with management*. *Work and Occupations*, 24, 426–452.
- [70] Holton, V., Dent, F., & Rabbetts, J. (2009). *Motivation and employee engagement in the 21st century: A survey of management views*. Ashridge.
- [71] Iverson, R. D. (1999). *An event history analysis of employee turnover: The case of hospital employees in Australia*. *Human Resource Management Review*, 9, 397-418.
- [72] Jaafar, M., Toh, K.I. & Siti, Z.Bt. Mohd. S. (2011). *Problem of small and medium of hotel operators*. 73-79.
- [73] John, P (2012). *The limits and the possibilities of employee engagement*.
- [74] Kahn, W. A. (1990). *Psychological conditions of personal engagement and disengagement at work*. *Academy of Management Journal*, 33(4), 692-724.
- [75] Kahn, W. A. (1992). *To be fully there: Psychological presence at work*. *Human Relations*, 45, 321–349.
- [76] Karatepe, O. M., & Olugbade, O. A. (2009). *The effects of job and personal resources on hotel employees' work engagement*. *International Journal of Hospitality Management*, 28(4), 504-512. <http://dx.doi.org/10.1016/j.ijhm.2009.02.003>
- [77] Ketter, P. (2008). *What's the big deal about employee engagement?* *Training and Development*, 44-49.
- [78] Kirchmeyer, C. (1995). *Managing the work-non-work boundary: an assessment of organizational responses*, *Human Relations*, 48, 515±536.

- [79] Kirkpatrick, D. L. (1998). *Evaluating training programs: The four levels* (2nd ed.). San Francisco, CA: Berrett-Koehler Publishers.
- [80] Kirkpatrick, D., & Kirkpatrick, J. (2005). *Transferring learning to behavior: Using the four levels to improve performance*. Berrett-Koehler Publishers.
- [81] Kitchenham, B., & Pfleeger, S. L. (2002). Principles of survey research: part 5: populations and samples. *ACM SIGSOFT Software Engineering Notes*, 27(5), 17-20.
- [82] Kompaso, S. M., & Sridevi, M. S. (2010). Employee engagement: The key to improving performance. *International Journal of Business and Management*, 5(12), p89.
- [83] Korunka C, Kubicek B, Schaufeli WB, Hoonakker P (2009). Workengagement and burnout: testing the robustness of the Job Demands-Resources model. *J. Positive. Psychol.*, 4(3): 243-255.
- [84] Kotteke, J. L., & Sharafinski, C. E. (1998). Measuring Perceived Supervisory and Organizational Support. *Educational and Psychological Measurement*, 48, 1075-1079
- [85] Krejcie and Morgan. (2013). Sample Size Determination Using Krejcie and Morgan Table. Retrieved from <http://www.kenpro.org/sample-sizedetermination-using-krejcie-and-morgan-table/>
- [86] Kular, S., & Gatenby, M. Rees Ch., Soane M., Truss E.(2008) Employee Engagement: a Literature Review (No. 19). Working Paper Series.
- [87] Lameck, W. U. (2013). Sampling Design, Validity and Reliability in General Social Survey. ISSN: 2222-6990. DOI: 10.6007/IJARBS/v3-i7/27. URL: <http://dx.doi.org/10.6007/IJARBS/v3-i7/27>
- [88] Laura. (2010). Leadership behaviors and employee engagement: The moderating effect of job insecurity. Lawrence, S. A. (2006). An integrative model of perceived available support work-family conflict and support mobilisation. *Journal of Management and Organization*, 12(2), 160-178.
- [89] Lee, J. (2012). Antecedents and consequences of employee engagement: empirical study of hotel employees and managers.
- [90] Lee, Huang, & Zhao (2012). A study on factors affect turnover intention of hotel employee
- [91] Leiter, M.P. & Maslach, C. (1988). The impact of interpersonal environment on burnout and organizational commitment. *Journal of Organizational Behavior*, 9, 297-308.
- [92] Lieke ten Brummelhuis, Jarrod M. Haar, Tanja van der Lippe (n.d.). Being there for co-workers And family: How balancing work and family roles affects collegiality at work, Retrieved from <http://www.buseco.monash.edu.au/mgt/research/acrew/worklife/tenbrummelhuis.pdf>
- [93] Little, B., & Little, P. (2006). "Employee engagement: Conceptual issues", *Journal of Organizational Culture, Communication & Conflict*, Vol.10, 111-120
- [94] Lockwood, N. R. (2007). Leveraging employee engagement for competitive advantage. *2007 SHRM Research Quarterly*, 52(3), 1-12.
- [95] Loehr & Schwartz, (2003). The power of full engagement.
- [96] Macey, W. H., & Schneider, B. (2008). The meaning of employee engagement. *Industrial and Organizational Psychology*, 1, 3-30.
- [97] Malik, F.A., Rubina and Adil, T, P. (2013). Connecting Training and Development with Employee Engagement: How Does it Matter?. *World Applied Sciences Journal*, 28(5), 696-703.
- [98] Mark S. Searle (1990). Social Exchange Theory as a Framework for Understanding Ceasing Participation in Organized Leisure Activities
- [99] Maslach, C., & Leiter, M. P. (1997). *The truth about burnout*. Jossey-Bass, San Francisco, CA.
- [100] Maslach, C. Schaufelli, W.B. and Leiter, M.P. (2001) „Job burnout“, *Annual Review of Psychology*, Vol 52, pp397-422.
- [101] Mauno, S., Kinnunen, U. & Ruokolainen, M. (2006). Job demands and resources as antecedents of work engagement: A longitudinal study. *Journal of vocational Behaviour*, 70, 149-171.
- [102] Maxwell, N. L. (2008). Wage differentials, skills, and institutions in low-skill jobs. *Industrial & Labor Relations Review*, 61, 394-409.
- [103] May, D. R. (2003). Fostering the human spirit at work: Toward an understanding of the influences on employees' experienced meaningfulness at work.
- [104] May, D. R., Gilson, R. L., & Harter, L. M. (2004). The psychological conditions of meaningfulness, safety and availability and the engagement of the human spirit at work. *Journal of Occupational and Organizational Psychology*, 77, 1-37.
- [105]McBain, R. (2006) "Employee engagement – the emergence of a new construct", *Henley Manager Update*, Vol. 17 No.4, pp.21-32.
- [106]McEwan,B.,1995, "On the Road to Quality", *Insider*, Vol12, No.4, pp.44-7.
- [107]McFarlane, D. A. (2006). Evaluating training programs: The four levels. *Journal of Applied Management and Entrepreneurship*, 11(4), 96-97. Retrieved from Business ABI/INFORM Global.
- [108]McKay & Avery (2007). Engaging the aging workforce: The relationship between perceived age similarity, satisfaction with co-worker, and the employee engagement.
- [109]Michael J. Tews, John W. Michel, Jill E. Ellingson (2013). The Impact of Coworker Support on Employee Turnover in the Hospitality Industry. *Journal of Group & Organization Management*, 38(5), pp. 630-653
- [110]Mirvis, P. H., & Macy, B. A. (1976). Accounting for the costs and benefits of human resource development programs: An interdisciplinary approach. *Accounting, Organizations and Society*, 1(2), 179-193.
- [111]Mitchell, T.R., Holtom, B.C., Lee, T.W., Sablinski, C.J., and Erez, M. (2001). „Why People Stay, Using Job Embeddedness to Predict Voluntary Turnover,“ *Academy of Management Journal*, 44, 6, 1102– 1122.
- [112]M. K. Duffy, D. C. Ganster, and M. Pagon. (2002). Social undermining in the workplace. *Academy of Management Journal*.
- [113]Monica & Mary (2007). Employee justice perceptions and co-worker relationship.
- [114]Moorman, R. H., Blakely, G. L., & Niehoff, B. P. (1998). Does Perceived Organizational Support Mediate the Relationship between Procedural Justice and Organizational Citizenship Behavior? *Academy of Management Journal*, No. 41, 351-357
- [115]Mullins, L.J.,1993 "The Hotel and the Open System Model of Organisational Analysis", *Service Industries Journal*, Vol.13,No.1,pp.1-16
- [116]Nadler, L., & Nadler, Z. (1989). *Developing human resources*. (3rd ed.). San Francisco: Jossey-Bass.
- [117]Ng, T. W. H., & Sorensen, K. L. (2008). Toward a further understanding of the relationships between perceptions of support and work attitudes: A metaanalysis. *Group & Organization Management*, 33, 243-268.
- [118]Noe, R. A. (2002). *Employee training and development*. Boston: McGrawHill/Irwin.
- [119]Olivier A.L., Rothmann. S. (2007). Antecedents of work engagement of the human spirit at work *journal of occupational and Organizational psychology*, Vol 33, No.3, 49-56.
- [120]Olsen, M.D., West, J.J., Tse, E.C.Y., 2008. *Strategic Management in the HospitalityIndustry*, third edition. Prentice Hall, New Jersey.
- [121]O. M. Karatepe, S. Keshavarz, and S. Nejati. (2010). Do core self-evaluations mediate the effect of co-worker support on work engagement? A study of hotel employees in Iran. *Journal of Hospitality and Tourism Management*, 17: 62-71.
- [122]Osman, M.K. (2012). Job resources, work engagement, and hotel employee outcomes: Time lagged Analysis. *Economic Research-Vol.25* (3), pp 644.
- [123]Poon, M.L. (2011). Effects of Abusive supervision and co-worker support of work engagement. Vol.22
- [124]PRASANNA, T. (2014). IMPACT OF EMPLOYEE ENGAGEMENT ON PERFORMANCE.
- [125]Rahman, M. H. M. H., & Rahman, A. (2013). Employee Perception towards Effective Training Program: A Study on Some Selective Private Commercial Banks. *European Journal of Business and Management*, 5(12), 62-74.
- [126]Reid, D., 1995, "Are We Really a Nation of Nesbits?", *Insider*, Vol.12, NO.4, pp.4 and 5
- [127]Rich, B. L., LePine, J. A., & Crawford, E.R. (2010). Job Engagement: Antecedents and Effects on Job Performance. *Academy of Management Journal*, 53, 617-635
- [128]Rocco, James M.; Jones, Allan P. (1978). Co-worker and leader support as moderators as stress -strain relationship in work situations.
- [129]Rothbard, N. P. (2001). Enriching or depleting? The dynamics of engagement in work and family roles. *Administrative Science Quarterly*, 46, 655-684.
- [130]Rothmann, S., & Rothmann Jr, S. (2010). Factors associated with employee engagement in South Africa. *SA Journal of Industrial Psychology*, 36(2), 1-12. Retrieved from http://www.scielo.org.za/scielo.php?pid=S207107632010000200005&script=sci_arttext&tlng=pt

- [131] Rothwell, W.J., & Sredl, H.J. (1992). *The ASTD reference guide to professional human resource development roles and competencies* (2nd ed.). Amherst, MA: HRD Press.
- [132] Rurkkhum, S. (2010). The relationship between employee engagement and organizational citizenship in Thai organizations.
- [133] Sacker, F., 1987, "Customer Service Training in Context", *Personnel Management*, Vol.19, No.3, pp.34-7.
- [134] Sahinidis, A. G., & Bouris, J. (2008). Employee perceived training effectiveness relationship to employee attitudes. *Journal of European Industrial Training*, 32(1), 63-76.
- [135] Saks, A. M. (2006). Antecedents and Consequences of Employee Engagement. *Journal of Managerial Psychology*, No. 21, 600-619
- [136] Salanova, M. & Schaufeli, W. (2005). Job resources, engagement and proactive behaviour: Across-national study. (Manuscript submitted for publication).
- [137] Salanova, M. & Schaufeli, W.B. (2008). Job resources, engagement and proactive behavior. *International Journal of Human Resource Management*, 19, 1161-131. Salas, E., Dickinson, T. L., Converse, S. A., & Tannenbaum, S. I. (1992). Toward an Understanding of Team Performance and Training. In R. W. Sweney and E. Salas (Eds), *Teams: Their Training and Performance* (pp. 3-29). Norwood, NJ: ABELIX
- [138] Salminen, S. R., Mäkikangas, A., & Feldt, T. (2014). Job Resources and Work Engagement: Optimism as Moderator Among Finnish Managers. *Journal of European Psychology Students*, 5(1), 69-77.
- [139] Schaufeli, W. B., & Bakker, A. B. (2003). Test manual for the Utrecht Work Engagement Scale. Unpublished manuscript, Utrecht University, the Netherlands
- [140] Schmidt, S. W. (2004). The relationship between satisfaction with on-the-job training and overall job satisfaction. Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education.
- [141] Sekaran, U. (2006). *Research methods for business: A skill building approach*. John Wiley & Sons. Pg266-268.
- [142] Sekaran, U. and Bougie, R. (2010). *Research Methods for Business: A Skill Building Approach*. UK: John Wiley & Sons.
- [143] Seyed Ali Akbar Ahmadi, Saeed Tavakoli, Paria Pourdarvish Heidary (2014). Perceived Organizational Support and Employee Engagement. *International Journal of Information Technology and Management Studies*, Vol. 1, Issue 1
- [144] Shafer, S. (2010). Professional development to promote employee engagement: A multi case study.
- [145] Sharma, S. C., & Choudhary, P. (2011). TRAINING AND DEVELOPMENT NEEDS IN THE HOSPITALITY INDUSTRY. Volume 1, Issue 5 (September, 2011) (ISSN 2231-4334)
- [146] Shuck, B., & Wollard, K. (2010). Employee engagement and HRD: A seminal review of the foundations. *Human Resources Development Review*, 9, 891-110.
- [147] Shuck, B., Reio Jr, T. G., & Rocco, T. S. (2011). Employee engagement: An examination of antecedent and outcome variables. *Human Resource Development International*, 14(4), 427-445.
- [148] Sirota, D., Mischkind, L., & Meltzer, M. (2005). *The Enthusiastic Employee: How Companies Profit by Giving Workers What They Want*. Upper Saddle River, NJ: Wharton School Publishing.
- [149] Swanson, R. A., & Holton, E. F. (2009). *Foundations of human resource development* (2nd ed.). San Francisco: Berrett-Koehler Publishers, Inc.
- [150] T. A. Beehr, S. M. Jex, B. A. Stacy, and M. A. Murray, (2000). Work stressors and co-worker support as predictors of individual strain and job performance. *Journal of Organizational Behaviour*, 21: 391-405.
- [151] TA Majid, MNA Azman, SAS Zakaria, AS Yahya, SS Zaini, MSS Ahmad (2011). Quantitative Analysis on the Level of IBS Acceptance in the Malaysian Construction Industry. *Journal of Engineering Science and Technology*, 6(2), 179-190
- [152] Tews, Michel, & Ellingson (2013). The impact of Co-worker support on employee turnover in the hospitality industry.
- [153] Thabane, L., Ma, J., Chu, R., Cheng, J., Ismaila, A., Rios, L.P. & Goldsmith, C.H. (2010). A tutorial on pilot studies: The what, why and how. *BMC Medical Research Methodology*, 10, Article 1. doi:10.1186/1471-2288-10-1
- [154] The Ken Blanchard Companies. (2008). *2008 corporate issues survey*. Guildford, United Kingdom: Author.
- [155] Thoits, P.A. (1982). Conceptual, methodological, and theoretical problems in studying social support as buffer against life stress. *Journal of Health and Social Behavior*, 23, 145-159.
- [156] Tomas Jungert (2012). The Meaning of Support from Co-workers and Managers in Teams when Working. Retrieved from <http://www.ibl.liu.se/fog/fograpporter/1.331304/fograpprnr72.pdf>
- [157] Tracey, W.R. (1984). *Designing training and development systems*. New York, N.Y.: American Management Association.
- [158] Truelove, S.(ed.),1992, *Handbook of Training and Development*. Oxford: Blackwell Publisher, pp.273 and 274.
- [159] Tseng ML, Wu WW, Lee CF. Knowledge Management Strategies in Linguistic Preferences. *Journal of Asia Pacific Business Innovation and Technology Management*, 1(1), 60-73
- [160] Ulrich, D. (1998). A new mandate for human resources. *Harvard Business Review*, 76, 1,124-134. Retrieved from Business ABI/INFORM Global.
- [161] Uma Sekaran (2003). *Research Method for Business: A Skill Building Approach*, 4th edition, John Wiley & Sons
- [162] Van den Broeck, A., Vansteenkiste, M., De Witte, H., & Lens, W. (2008). Explaining the relationships between job characteristics, burnout, and engagement: The role of basic psychological need satisfaction. *Work & Stress*, 22(3), 277-294.
- [163] Vemić, J. (2007). Employee training and development and the learning organization. *Facta universitatis-series: Economics and Organization*, 4(2), 209-216.
- [164] Wang, J.H. (2003). Influence of Compensation on Loyalty to Organization.
- [165] Wang, Y. (2005). Strategic employee training and development in Chinese luxury hotels. MPRA Paper No. 25405
- [166] Weinstein, M. (2007). Assessment acumen. *Training*, 44(1), 32-44. Retrieved August 10,2007, from Business ABI/INFORM Global.
- [167] Welfald, A. J., & Downey, R. G. (2009). Construct dimensionality of engagement and its relation with satisfaction.
- [168] Wexley, K.N. and G.P. Latham, 1991, *Developing and training Human Resource in Organisation*, 2nd edition, New York: Harper Collins Publisher, p.3.
- [169] Winfrey, E. C. (1999). Kirkpatrick's four levels of evaluation. *Encyclopedia of educational technology*.
- [170] Wright (2009). Role stressors, Co-worker, and work engagement: A longitudinal study.
- [171] Zenger, T., & Lawrence, B. (1989). Organizational demography: The differential effect of age and tenure distribution on technical communications.
- [172] Zhou, J. and George, J.M. (2001). When job dissatisfaction leads to creativity: encouraging the expression of voice. *Academy of Management Journal*, Vol. 44 No. 4, pp. 683-96.
- [173] Zikmund, W. G. (2003). *Business Research Method* (7th ed.). South-Western Publishing

AUTHORS

First Author – Pei-Yew Lai, Universiti Tunku Abdul Rahman,
Second Author – Jee-Sin Lee, Universiti Tunku Abdul Rahman
Third Author – Yu-Xiang Lim, Universiti Tunku Abdul Rahman
Correspondence Author – Ray-Gin Yeoh, Universiti Tunku Abdul Rahman
Correspondence Author – Farhana Hanim Mohsin, Universiti Tunku Abdul Rahman

Laser Induced Breakdown Spectroscopy for Identification & Quantification of Elemental Composition of Steel Structures: A Study of Early Stage Rust Behaviour in Steel

Osayuwamen Ogboghodo

University of Aberdeen, School of Engineering, Aberdeen, AB24 3UE, United Kingdom

Abstract- The investigation of the signal intensity and plasma temperature parameters involved with steel structures experiencing early stage rust are described. A simple laboratory set-up involving a ruby laser, mirror, focusing lens, collecting optics and a miniaturised spectrometer were used to conduct the experiments. The spectra from the first two shots on the rust steel sample correlates to that of the rust layers where Carbon (C) was the only sensitive element detected. However, the significant presence of C in subsequent shots could be as a result or a combination of: material alteration due to the rust layer, presence of the analyte line in both the layer and underlying bulk material; and residual rust particles still present in the crater or perimeter of the ablation region. Investigating the temperature parameter for both the rust layer and regular surface showed no significant distinction in the values.

I. INTRODUCTION

Laser Induced Breakdown Spectroscopy (LIBS) is a useful technique for material characterisation in terms of elemental composition and quantification. Because of its relatively fast measurement, LIBS can be used for real time, *in situ* analysis without the hassle of exporting the target sample back to the laboratory. Furthermore, LIBS is suitable for non-destructive and non-invasive testing of materials since a small amount of mass and surface area is usually interrogated by the laser. LIBS for field applications require no elaborate equipment set-up and sample preparation [1-10].

LIBS analysis of steel mainly involves the identification of atomic constituents of the sample and with useful calibration standards, determining its concentration (quantitative/semi-quantitative analysis). Rust layers on steel often indicate the presence of iron oxides [1-7] [11-16].

For qualitative analysis, identifying the element emissions in air due to higher ionised species ($>10\text{eV}$) could be difficult because electron-ion recombination (to form neutrals) occurs early due to the restricted plasma expansion [1] [3] [7] [17-18]. As the ambient pressure decreases in air (after the laser shot), the plasma lifetime also decreases due to less trapping and recycling of the absorbed energy in the plasma volume thus species with higher ionisation potential will have recombined with free electrons in the cooling plasma [1-3] [5-6] [19]. In vacuum, the plasma expands freely away from the surface with the ions, electrons, atoms/molecules (ejecta) expanding at different

speeds, thus recombination process occurs at a much latter stage as opposed to air [7]. In water, there is even more difficulty as the plasma exhibits strong plasma confinement and quenching effects making the lifetime of the plasma too short and presence of highly ionised species unlikely. The resulting spectrum is typically dominated by intense background light with little spectroscopic information and broadened emission lines due to the high optical density of the plasma. In some cases, only major elements from ablated samples can be detected. Poor signal output can be attributed to the thermal conductivity, density and incompressible nature of water. Also, majority of the pulse energy after absorption losses is used to create vapour cavity on the solid surface with little or no energy used for excitation purposes [10] [19-38]. However, LIBS signals from rust steel underwater are somewhat low and the ablated particles reduce the water transparency for subsequent laser shots [36].

Yao et al. studied and compared the plasma parameters (line intensity, temperature and ablated crater) of different microstructures from a single steel sample to discriminate pearlitic/ferritic from martensitic phases [39]. AbdelKareem et al. investigated the rust and regular surfaces of metal threads with copper as the main component. Converging results were acquired from LIBS and EDX (Energy- Dispersive X-Ray Spectroscopy) analysis on the clean surface; but LIBS could not detect some elements such as Chlorine and Sulphur when interrogating rust surfaces [18]. Nasrazadani and Namduri also studied the phase transformation in iron oxides. Linear correlation procedures compared the samples to commercial iron oxide powders where correlation values of close to one were achieved [15]. Boue-Bigné extended LIBS applications for fast micro-analysis technique to monitor segregation and decarburisation for improved quality of the final product in the steel manufacturing industry. Concentration maps showed the presence of segregation elements and decarburisation layers [14]. Kim et al. developed a portable LIBS system to monitor paints and coatings using peak picking and correlation algorithms. They were able to obtain matches of above 90% with reference paint samples [40]. Ardakani and Tavassoli conducted depth profile analyses of coated and attached layers on steel and aluminium substrates where their interfacial parameters showed no effects on laser ablation. Using normalised intensity for interface position is not entirely accurate as it depends on plasma temperature and pulse energy. Normalised concentration provided better depth resolution in comparison [41]. Hemmerlin

et al. analysed steel samples using Vacuum Ultraviolet LIBS and compared results with Spark Discharge-Optical Emission Spectroscopy (SD-OES) [42]. Similar sensitivities were obtained for identifying elements of interest related to process control in steel manufacturing. SD-OES showed better Limits of Detection (LOD) in agreement with [18].

Carbon steel as an engineering material accounts for a great percentage of steel production worldwide even with its limited corrosion resistance. It is used in nuclear and fossil fuel power plants, transportation, marine, petroleum production and refining, pipelines, chemical processing, metal processing, mining and construction. In an event where carbon steel is exposed to moist air or a thin film of water, rust formation can accelerate further in an atmosphere containing gaseous atmospheric constituent capable of strong electrolytic activity.

In hazardous areas where physical access is not possible, LIBS can be a useful tool for *in situ* analysis on steel structures experiencing early stage (I/II) rust; providing single shot spectroscopic information from repetitive sampling at the same location to interrogate both the non-uniform surface and underlying bulk composition. This paper aims to investigate signal intensity as well as plasma temperature parameters of rust steel and identify analyte elements from the surface alteration due to early stage rust.

II. EXPERIMENTAL

Ruby laser of wavelength, pulse width and repetition rate of 694.3 nm, 50 ns, 0.1 Hz respectively were used to interrogate the sample. The pulse energy was kept relatively stable at about 30 mJ through the experiments. The pulse energy level prevented excess material ablation on the rust layer particularly after the first laser pulse and allowed for proper shot-to-shot material analysis.

The laser pulse was directed to the sample via a ruby 45° mirror and 110 mm UV fused silica lens. The collecting optics compacted in an optical cage consisted of:

- Thor labs LB4592 UV fused silica bi-convex uncoated lens with focal length ($f= 60$ mm), diameter ($\varnothing=50.8$ mm)
- Thor labs LB4821 UV fused silica bi-convex uncoated lens with focal length ($f= 100$ mm), diameter ($\varnothing=50.8$ mm)
- Short-pass filter placed between the LB4821 lens and the fibre optic probe to cut-off wavelength above 650 nm, preventing both signal intensity saturation and potential damage of the fibre optic cable

The 600 μm core diameter fibre optic cable was positioned at the end of the cage to collect and transmit plasma light to the entrance slit of the ocean optics USB 2000+ spectrometer with the integration time set to 1ms. The flashlamp of the laser was internally triggered with a Q-switch delay of 1200 μs . To resolve the spectral window against background light and for optimum signal, the pulse generator was used to adjust the delay (to about 1200 μs) between the flashlamp sync pulse and output trigger pulse to the spectrometer. The measured spectrometer delay was

about 3.75 μs . The hollow cylindrically shaped mild steel sample was interrogated with single laser shots and the resulting spectra recorded. 10 individual laser shots were fired on the sample's regular and rust surface to maintain consistency in comparison. Carbon steel Certified Reference Material (CRM) was to compare variations of the regular surface's analyte signal.



Fig 1. Mild Steel sample showing rust layer and regular surface sections

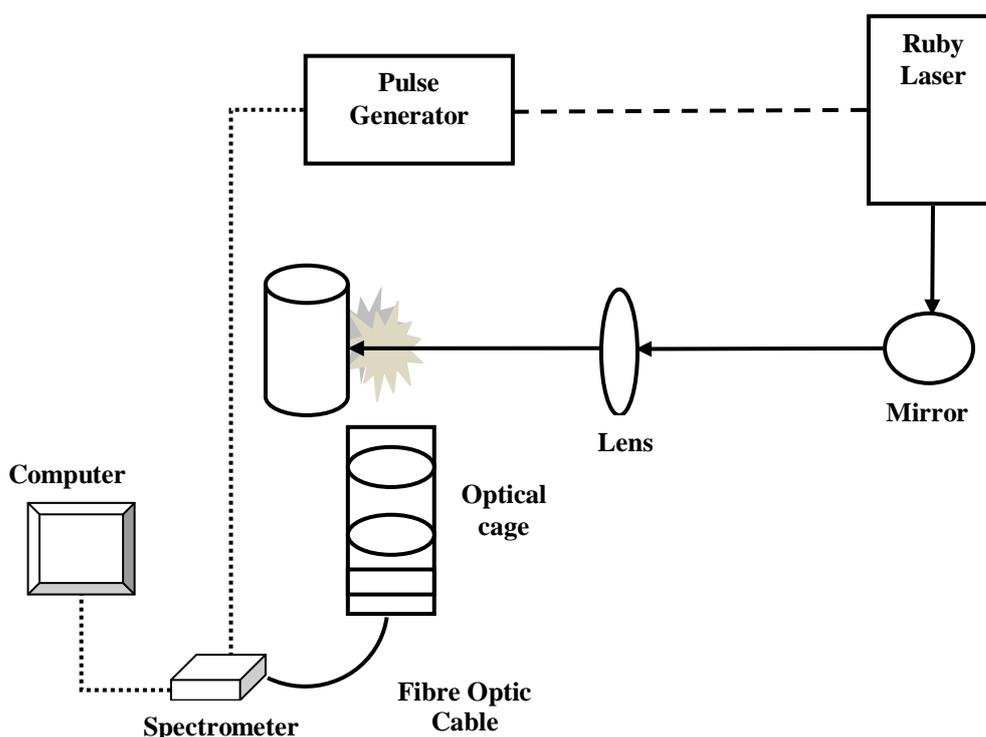


Fig 2. Laboratory based LIBS set-up

III. RESULTS AND DISCUSSION

The first 2 shots on the rust layer show the absence of the sensitive bulk matrix [Fe (I)] lines within the spectral

window which could only be observed clearly from the 4th shot onwards after more layer ablation and interrogation of

the bulk composition (Figure 3). This could imply that the spectra from the initial two shots depicts to a level, the characteristics of the rust layer. Although the first shot yields no meaningful spectroscopic information, the second shot shows the presence of the 588.9 nm analyte (C) line. From the 4th to 10th shot where sensitive bulk matrix lines appear, the analyte line is still persistent with significant intensity. This indicates the analyte is present in

both the layer and underlying bulk material. Comparing with the spectra from the regular surface (Figure 4a), the analyte line is only significant in the first shot but no clear observations in subsequent shots as the lines appear indistinct. Figure 5 shows the intensity variations of the analyte and bulk matrix lines with shot number for the regular surface and rust layer.

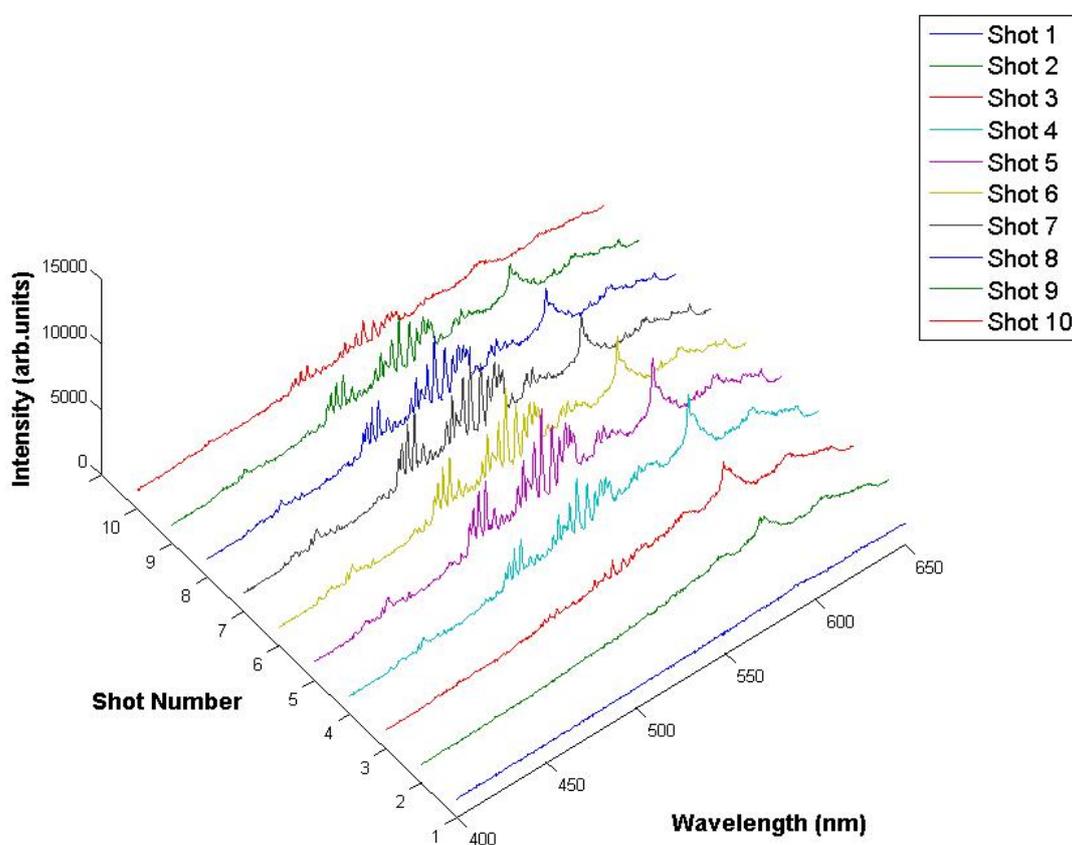


Fig 3. LIBS spectra obtained from the rust layer section over 10 shots

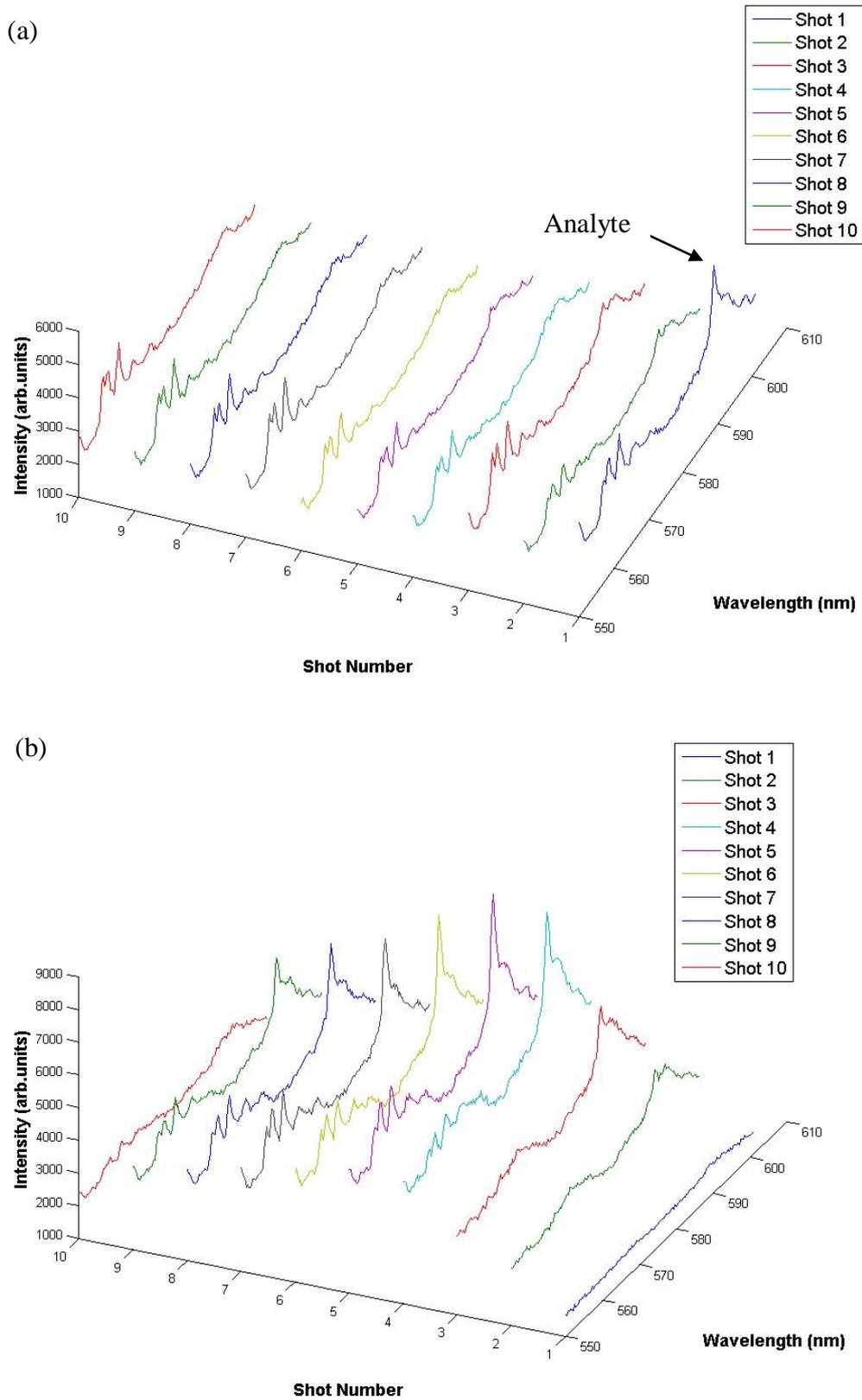


Fig 4 LIBS spectra obtained from regular surface (a) and rust layer (b) section highlighting the analyte line variations with shot number

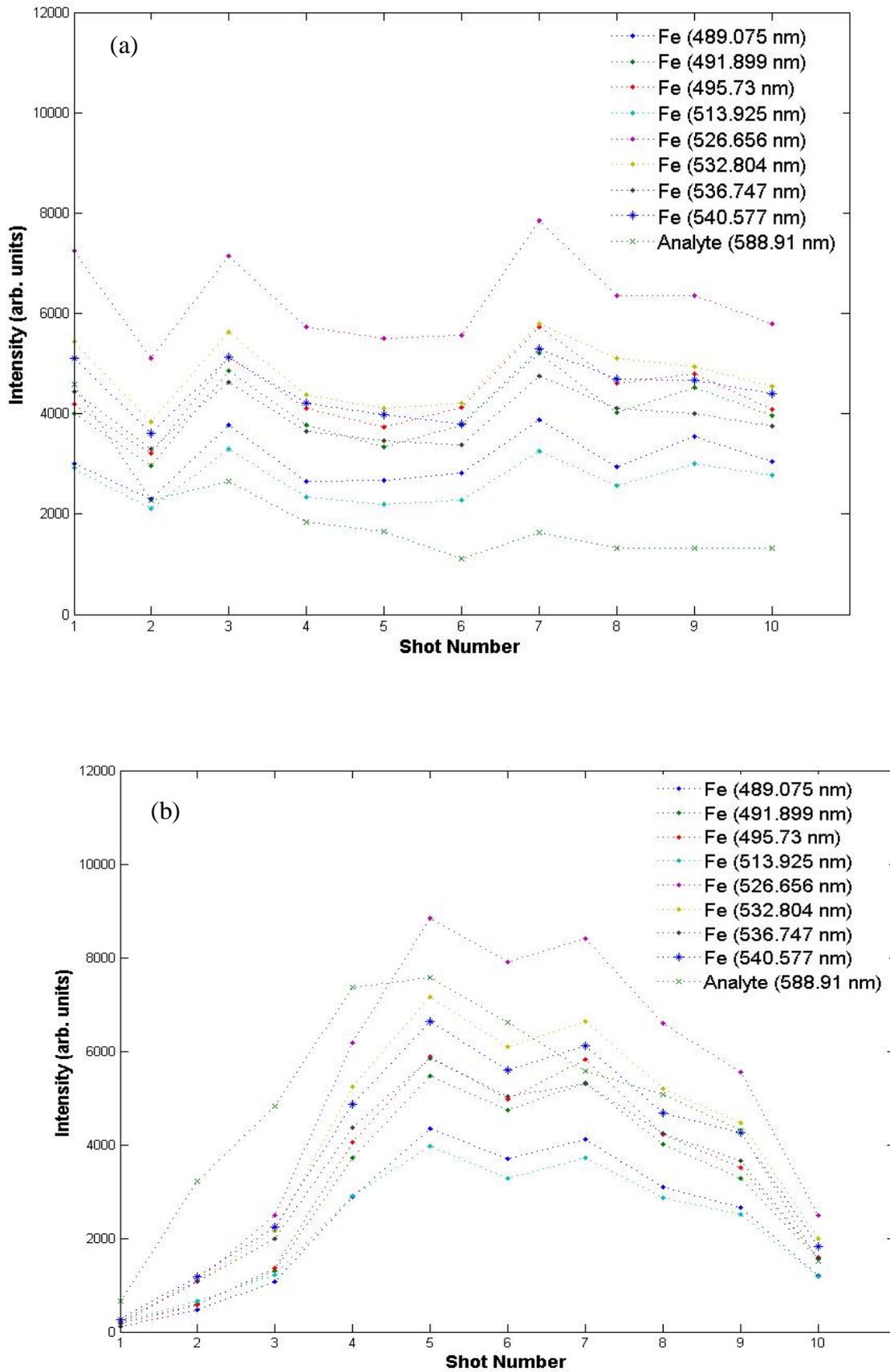
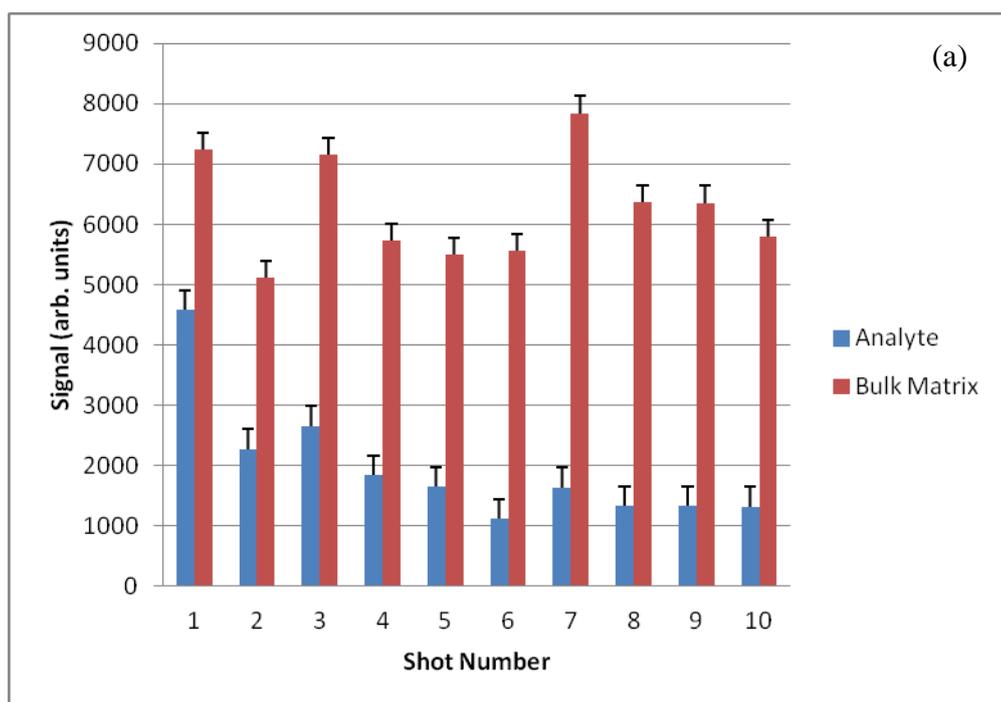


Fig 5. Signal Intensity variation with shot number for analyte and bulk matrix lines [(a) regular surface, (b) rust layer]

The contrast in the analyte line intensity behaviour could be attributed to the layer characteristics. The rust layer spectra observation shows similarities to interrogating a layered material; except in this case, a particular analyte line sensitivity relating to the layer composition still persists after layer ablation. To further validate the results seen in figure 5, the most sensitive Fe bulk matrix line (526.65 nm) and the analyte line signals were investigated for the carbon steel sample (regular surface and rust layer) and compared with the CRM sample – carbon steel (Figure 6). The standard error bars were inserted to acknowledge shot-to-shot plasma variation from the single laser shots. The CRM sample containing 0.598 % C; shows similarities to the regular surface of the test carbon steel sample in terms of the

variation trend in the analyte signals. Although, the CRM shows a better measure of signal repeatability as seen in the lower error bars (Figure 6c). Greater error bars in the measured analyte signal observed in figure 6b could be attributed to the surface non-uniformity from the rust process. The presence of useful quantity carbon in the rust layer spectra could be as a result of the presence of iron carbide in the steel structure and the subsequent leaching with Fe to form solutions in the event of rust. In steel, none of carbon is present on its own as it is all dissolved in the iron as part of the microstructures during manufacturing. Depending on the stage, rust process could produce a new and less desirable material from the original steel product. However, these deductions will have to be validated with further experiments.



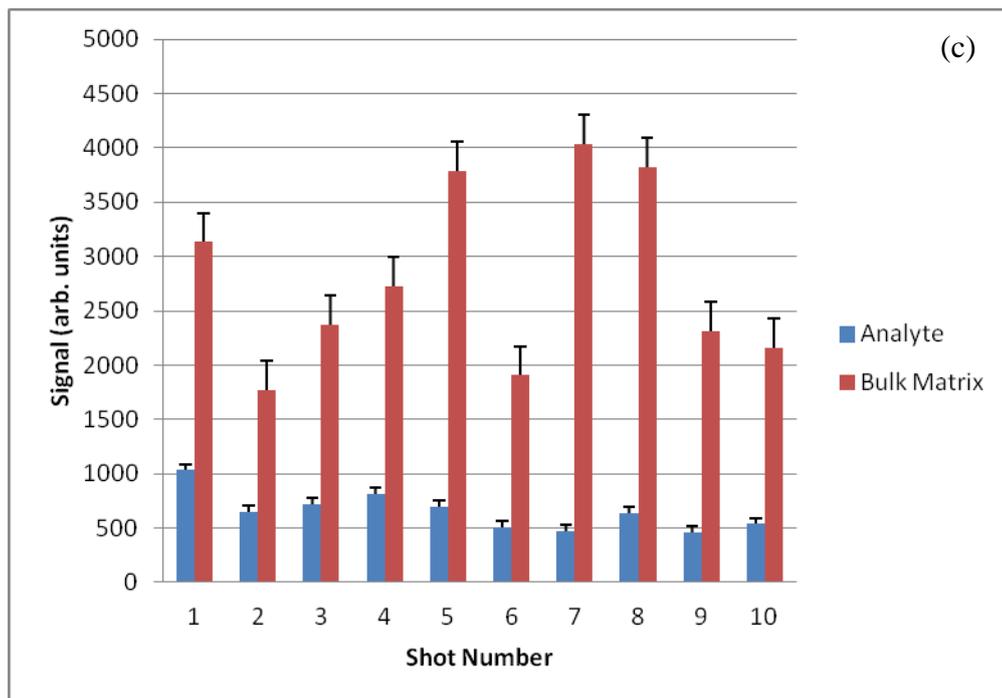
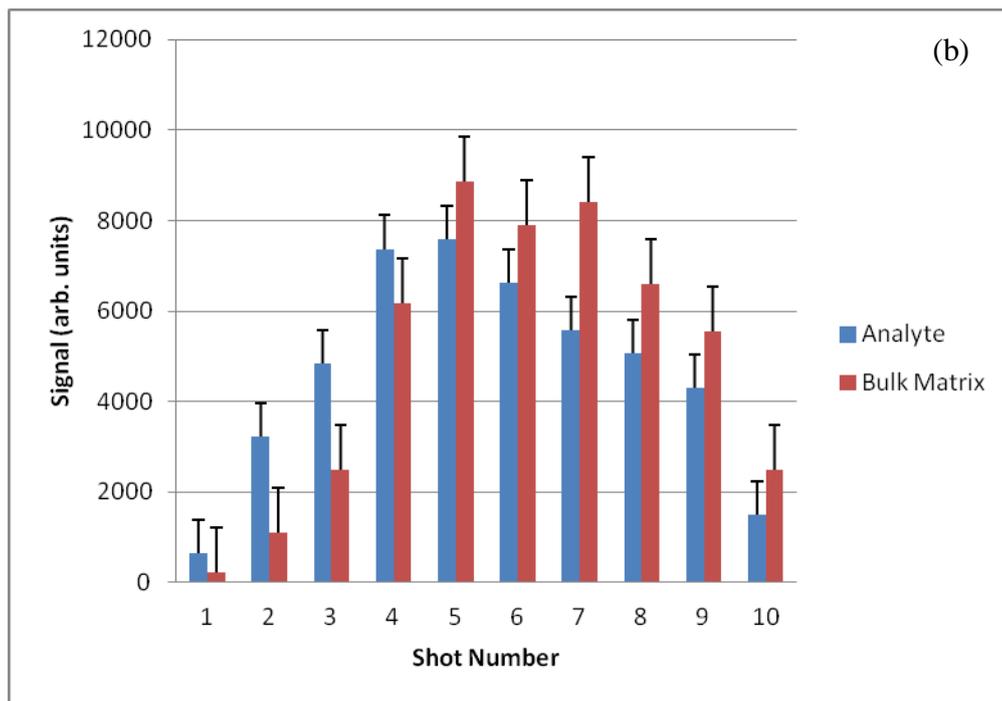


Fig 6. Signal Intensity variation with shot number for analyte and bulk matrix line (Fe/526.65 nm) [(a) regular surface, (b) rust layer, (c) CRM - Carbon Steel]

8 bulk matrix Fe lines (ranging from 488 nm to 540 nm) were selected and its intensity variation investigated and compared with the analyte line (C) for both rust layer and regular surface as shown in figure 5. The selected lines

were subsequently used for Boltzmann plot to measure the temperature and observe a similar variation for each shot. The plasma temperature calculated from each plot is dependent on experimental parameters such as the time

delay, integration time (gate width) and measured signal intensity. The slope (eV^{-1}) of the linear plot and the Boltzmann constant (eV/K) were used to determine the

Boltzmann temperature. Table 1 shows the temperature and slope results from the Boltzmann plots.

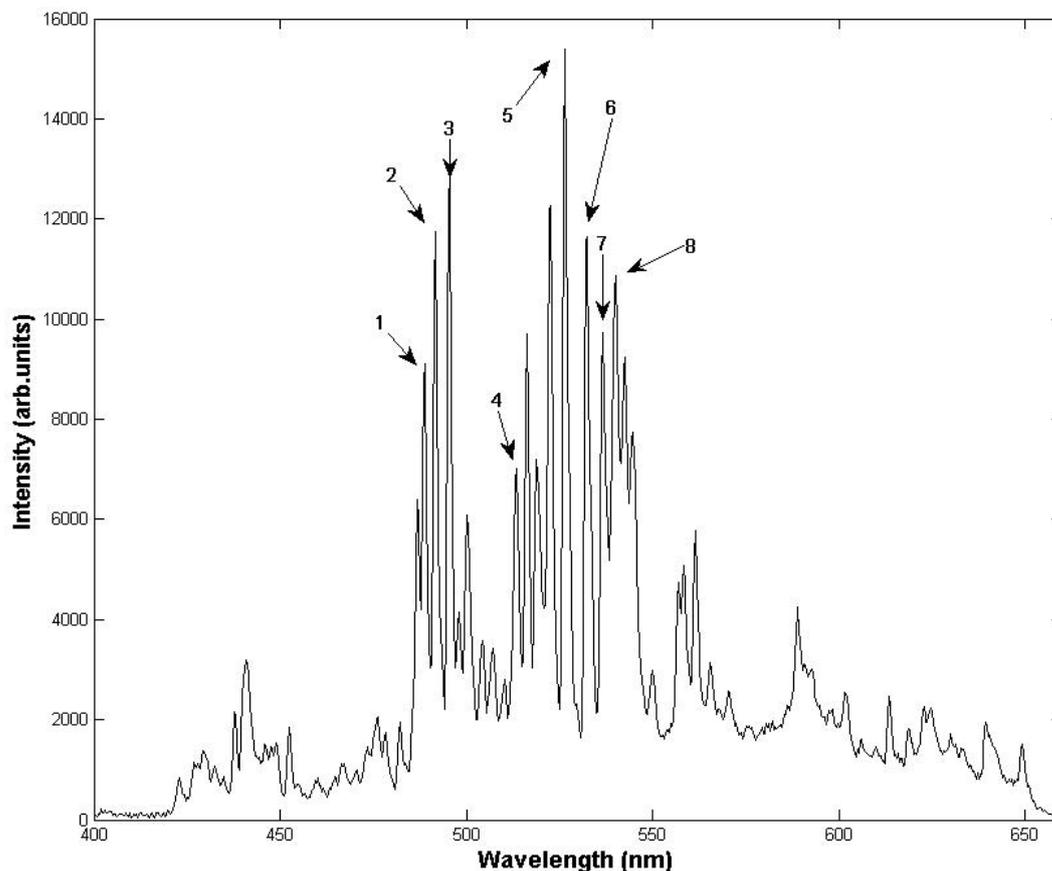


Fig 7. Selected Fe lines used for Boltzmann plot to measure the plasma temperature

Table 1 Plasma temperature results generated from the Boltzmann plots.

	Temperature			Slope		
	Value (K)	Accuracy Error (%)	Standard Error (K)	Value (eV^{-1})	Accuracy Error (%)	Standard Error (eV^{-1})
Regular Surface	7976 ± 57	0.7	± 18	-1.455 ± 0.01	0.7	± 0.003
Rust Layer	7886 ± 75	0.95	± 24	-1.4716 ± 0.014	0.96	± 0.004
CRM – carbon Steel	7882 ± 86	1.1	± 27	-1.4724 ± 0.016	1.1	± 0.005

Temperature variations relating to the Regular surface, Rust Layer and CRM for each shot are shown in figure 8. There is no significant distinction as observed in the signal intensity investigation. Under the same experimental conditions, the rust layer showed the highest mean temperature value over 10 shots. The results in table 1 validate the experimental accuracy of LIBS for single shot interrogation because of the accuracy errors (not greater than 1.1 %). The calculated plasma temperature relies strongly on the slope of the Boltzmann plots and thus, temperature accuracy is also dependent on the standard error of the slope. Values of intercept in Boltzmann plots are rarely used to validate the accuracy of the measured plasma temperature. To ensure some sort of reliability of using temperature measurements to characterise the rust sample using LIBS, approximations must be adopted to define the plasma state.

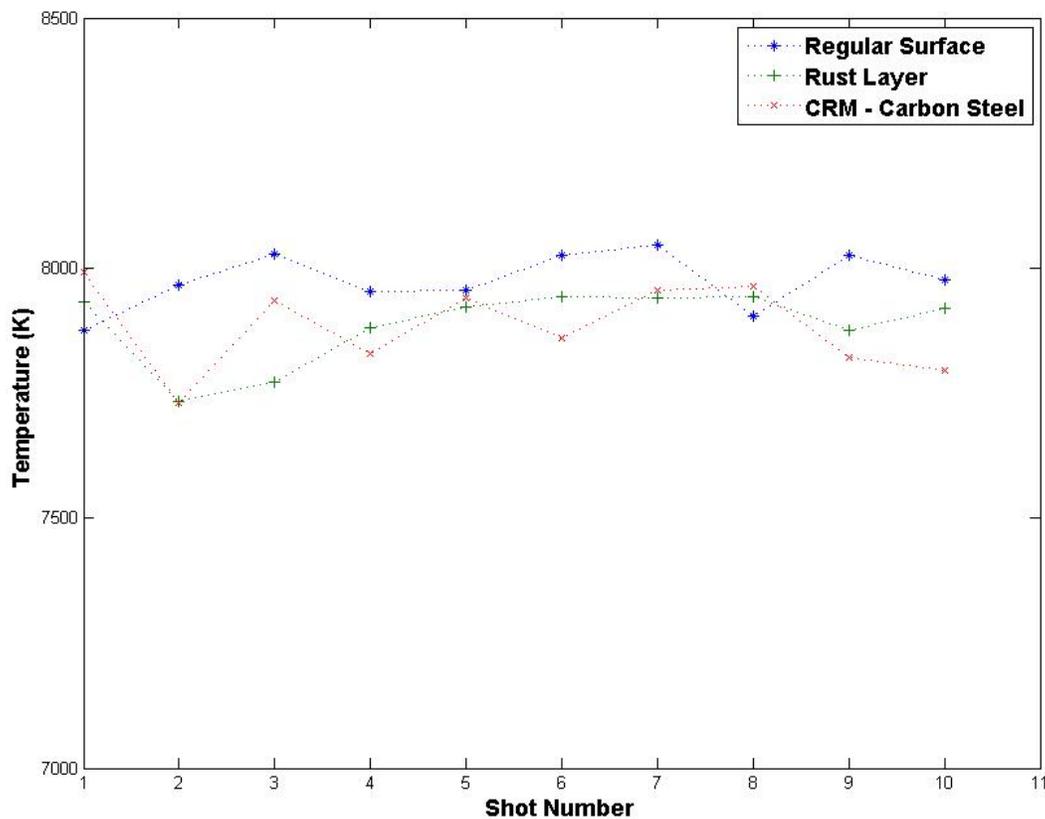


Fig 8. Temperature variation with shot number for the clean surface and rust layer sections

IV. CONCLUSION

LIBS usefulness as a method to interrogate rust metals lies on its repeatability, invasiveness, accessibility and analytical power. The spectra from the first two shots on the carbon steel sample correlates to that of the rust layers where C was the only sensitive element detected. However, the significant presence of C in subsequent shots could be as a result or a combination of: material alteration with respect to the bulk composition owing to the rust layer, presence of the analyte line in both the layer and

underlying bulk material and residual rust particles still present in the crater of the ablated region. Investigating temperature variation with shots for both rust and clean surface did not result greatly in distinguishing rust layer characteristics.

Results from studying fundamental intensity and temperature parameters validate to confident degree, LIBS as a fast, real-time, *in situ* analytical tool for providing spectroscopic information from repetitive sampling.

Further work will involve:

- Studying the effects of the presence of the underlying bulk material of steel on LIBS signal related to the rust layer.
- Studying the effects of pulse energy on spectra analysis relating to bulk matrix and analyte signal intensity; and investigating what pulse energy range has the most reduced influence on bulk matrix and analyte signal interaction.
- Investigating the effects of rust layer and underlying bulk composition have in identifying higher ionised elements of interest (notably Fe).

REFERENCES

- [1] Singh, Jagdish P, Thakur, Surya N. Laser-Induced Breakdown Spectroscopy; 2007.
- [2] Radziemski LJ, Cremers DA. Laser-Induced Plasmas and Applications; 1989.
- [3] Noll R. Laser-Induced Breakdown Spectroscopy. : Springer-Verlag Berlin Heidelberg; 2012.
- [4] Laser Induced Breakdown Spectroscopy (LIBS): Application to material processing. Pacific Rim Conference on Lasers and Electro-Optics, CLEO - Technical Digest; 2009.
- [5] Musazzi S, Perini U. Laser-Induced Breakdown Spectroscopy: Theory and Applications. : Springer; 2014.
- [6] Miziolek AW, Palleschi V, Schechter I. Laser-Induced Breakdown Spectroscopy (LIBS): fundamentals and applications. : Cambridge University Press; 2006.
- [7] Cremers DA. Handbook of Laser-Induced Breakdown Spectroscopy. Chichester : John Wiley & Sons; 2006.
- [8] Stelmasczyk K, Rohwetter P, Méjean G, Yu J, Salmon E, Kasparian J, et al. Long-distance remote laser-induced breakdown spectroscopy using filamentation in air. Applied Physics Letters 2004; 85(18):3977-3979.
- [9] LAT 2010: International Conference on Lasers, Applications, and Technologies. Proceedings of SPIE - The International Society for Optical Engineering; 2011.
- [10] The First International Conference on Laser-Induced Plasma Spectroscopy and Applications (LIBS 2000). Spectrochimica Acta - Part B Atomic Spectroscopy; 2001.
- [11] Different calibration strategies to overcome matrix effect in steel analysis by Laser-Induced Breakdown Spectroscopy. Proceedings of SPIE - The International Society for Optical Engineering; 2011.
- [12] Rapid analysis of steels using laser-based techniques. Proceedings of the Process Technology Conference; 1985.
- [13] Gruber J, Heitz J, Strasser H, Bäuerle D, Ramaseder N. Rapid in-situ analysis of liquid steel by Laser-Induced Breakdown Spectroscopy. Spectrochimica Acta - Part B Atomic Spectroscopy 2001; 56(6):685-693.
- [14] Boué-Bigne F. Laser-Induced Breakdown Spectroscopy applications in the steel industry: Rapid analysis of segregation and decarburization. Spectrochimica Acta - Part B Atomic Spectroscopy 2008; 63(10):1122-1129.
- [15] Nasrazadani S, Namduri H. Study of phase transformation in iron oxides using Laser-Induced Breakdown Spectroscopy. Spectrochimica Acta - Part B Atomic Spectroscopy 2006; 61(5):565-571.
- [16] Sturm V, Peter L, Noll R. Steel analysis with Laser-Induced Breakdown Spectrometry in the vacuum ultraviolet. Applied Spectroscopy 2000; 54(9):1275-1278.
- [17] Investigation of historical metal objects using Laser Induced Breakdown Spectroscopy (LIBS) technique. THE 8TH INTERNATIONAL CONFERENCE ON LASER APPLICATIONS-ICLA 2011: AIP Publishing; 2011.
- [18] Application of Laser Induced Breakdown Spectroscopy (LIBS) Technique in Investigation of Historical Metal Threads. THE 7TH INTERNATIONAL CONFERENCE ON LASER APPLICATIONS—ICLA 2009: AIP Publishing; 2009.
- [19] Laser-Induced underwater plasma and its spectroscopic applications. AIP Conference Proceedings; 2008.
- [20] Thornton B, Ura T. A study of Laser-Induced Breakdown Spectroscopy for analysis of the composition of solids submerged at oceanic pressures. OCEANS 2011. Proceedings of MTS/IEEE Conference; 2011.
- [21] Thornton B, Ura T. Effects of pressure on the optical emissions observed from solids immersed in water using a single pulse laser. Applied Physics Express 2011; 4(2).
- [22] Laser-Induced Breakdown Spectroscopy for in situ chemical analysis at sea. 2013 IEEE International Underwater Technology Symposium, UT 2013; 2013.
- [23] Simileanu M, Radvan R. Remote method and set-up for the characterization of the submerged archaeological remains. Journal of Optoelectronics and Advanced Materials 2011; 13(5):528-531.
- [24] Pichahchy AE, Cremers DA, Ferris MJ. Elemental analysis of metals underwater using Laser-Induced Breakdown Spectroscopy. Spectrochimica Acta - Part B Atomic Spectroscopy 1997; 52(1):25-39.
- [25] Oceanic applications of Laser-Induced Breakdown spectroscopy: laboratory validation. OCEANS, 2005. Proceedings of MTS/IEEE Conference; 2005.
- [26] Characteristics of pulsed discharge plasma in water. Digest of Technical Papers-IEEE International Pulsed Power Conference; 2007.
- [27] Spectroscopy and imaging of Laser-Induced Plasmas for chemical analysis of bulk aqueous solutions at high pressures. OCEANS 2011. Proceedings of MTS/IEEE Conference; 2011.
- [28] Matsumoto A, Tamura A, Fukami K, Ogata YH, Sakka T. Single-pulse underwater Laser-Induced Breakdown Spectroscopy with non-gated detection scheme. Analytical Chemistry 2013; 85(8):3807-3811.
- [29] Evaluation of Laser-Induced Breakdown Spectroscopy (LIBS) as a new in situ chemical sensing technique for the deep ocean. OCEANS 2006. Proceedings of MTS/IEEE Conference; 2006.
- [30] A novel approach for LIBS enhancement of cations underwater. Proceedings of SPIE - The International Society for Optical Engineering; 2009.
- [31] Lu Y, Li Y, Wu J, Zhong S, Zheng R. Guided conversion to enhance cation detection in water using Laser-Induced Breakdown Spectroscopy. Applied Optics 2010; 49(13):C75-C79.
- [32] Lazic V, Laserna JJ, Jovicevic S. Insights in the Laser-Induced Breakdown Spectroscopy signal generation underwater using dual pulse excitation - Part I: Vapour bubble, shockwaves and plasma. Spectrochimica Acta - Part B Atomic Spectroscopy 2013; 82:42-49.
- [33] Lazic V, Jovicevic S, Fantoni R, Colao F. Efficient plasma and bubble generation underwater by an optimized laser excitation and its application for liquid analyses by Laser-Induced Breakdown Spectroscopy. Spectrochimica Acta - Part B Atomic Spectroscopy 2007; 62(12):1433-1442.
- [34] Lazic V, Colao F, Fantoni R, Spizzichino V, Jovičević S. Underwater sediment analyses by Laser-Induced Breakdown Spectroscopy and calibration procedure for fluctuating plasma parameters. Spectrochimica Acta - Part B Atomic Spectroscopy 2007; 62(1):30-39.
- [35] Lazic V, Colao F, Fantoni R, Spizzichino V. Recognition of archaeological materials underwater by Laser-Induced Breakdown Spectroscopy. Spectrochimica Acta - Part B Atomic Spectroscopy 2005; 60(7-8):1014-1024.
- [36] Lazic V, Colao F, Fantoni R, Spizzichino V. Laser-Induced Breakdown Spectroscopy in water: Improvement of the detection threshold by signal processing. Spectrochimica Acta - Part B Atomic Spectroscopy 2005; 60(7-8):1002-1013.
- [37] Beddows DCS, Samek O, Liška M, Telle HH. Single-pulse Laser-Induced Breakdown Spectroscopy of samples submerged in water using a single-fibre light delivery system. Spectrochimica Acta - Part B Atomic Spectroscopy 2002; 57(9):1461-1471.
- [38] De Giacomo A, Dell'Aglio M, De Pascale O, Capitelli M. From single pulse to double pulse ns-Laser Induced Breakdown Spectroscopy under water: Elemental analysis of aqueous solutions and submerged solid samples. Spectrochimica Acta - Part B Atomic Spectroscopy 2007; 62(8):721-738.
- [39] Yao S, Lu J, Chen K, Pan S, Li J, Dong M. Study of Laser-Induced Breakdown Spectroscopy to discriminate pearlitic/ferritic from martensitic phases. Applied Surface Science 2011; 257(7):3103-3110.
- [40] Kim T, Nguyen BT, Minassian V, Lin C-. Paints and coatings monitored by Laser-Induced Breakdown Spectroscopy. Journal of Coatings Technology Research 2007; 4(3):241-253.

- [41] Ardakani HA, Tavassoli SH. Numerical and experimental depth profile analyses of coated and attached layers by Laser-Induced Breakdown Spectroscopy. *Spectrochimica Acta - Part B Atomic Spectroscopy* 2010; 65(3):210-217.
- [42] Hemmerlin M, Meilland R, Falk H, Wintjens P, Paulard L. Application of vacuum ultraviolet Laser-Induced Breakdown Spectrometry for steel analysis - Comparison with Spark-Optical Emission Spectrometry figures of merit. *Spectrochimica Acta - Part B Atomic Spectroscopy* 2001; 56(6):661-669.

AUTHORS

First Author – Osayuwamen Ogboghodo, University of Aberdeen, School of Engineering, Aberdeen, AB24 3UE, United Kingdom, Email: r01oo11@abdn.ac.uk

An Analysis of the Effects of Inventory Management on the Performance of the Procurement Function of Sugar Manufacturing Companies in the Western Kenya Sugar Belt

Cynthia Mito Mukopi¹, Dr. Amuhaya Mike Iravo²

¹ Master of Science in Procurement and Logistics, Jomo Kenyatta University of Agriculture and Technology

² Supervisor, Jomo Kenyatta University of Agriculture and Technology

Abstract- The research project examined the effect of inventory management on performance of the procurement function of sugar manufacturing companies in the western sugar belt. The first objective established the significance of a lean inventory system on the performance of the procurement function of sugar manufacturing companies in the western sugar belt. The second objective found out how strategic supplier partnerships in inventory management affect the performance of the procurement function of sugar manufacturing companies in the western sugar belt. The third objective investigated the effect of information technology in inventory management on the performance of the procurement function of sugar manufacturing companies in the western sugar belt. The fourth objective examined the effect of the legal policies on inventory management in the sugar industry on the performance of the procurement function of sugar manufacturing companies in the western sugar belt. Descriptive research design, specifically a survey study was employed in carrying out the research. The target population of the study consisted of a sample of procurement personnel of Mumias Sugar Company, West Kenya Sugar Company, Nzoia Sugar Company and Butali Sugar Mills which was 30 procurement personnel out of the total target population that was 100 procurement personnel. The research instrument was structured questionnaires that were self administered to the respondents. Data was analyzed using SPSS and presented in tables and charts. The response rate was 87%. The ANOVA result for all variables indicated that there was a highly significant relationship between the variables at $F = 2.727$ and $P = 0.000$. This means that there is a strong relationship between the four variables; lean inventory systems, strategic supplier partnerships, information technology, legal policies and the effect of inventory management on performance of the procurement function of sugar manufacturing companies in the western sugar belt.

Index Terms- Inventory management, Procurement Function, Performance

I. INTRODUCTION

Inventory management is a critical management issue for manufacturing companies. Inventories are vital to the successful functioning of manufacturing organizations.

According to Buffa and Sarin (2007) there are several reasons for keeping inventory. Too much stock could result in funds being tied down, increase in holding cost, deterioration of materials, obsolescence and theft. On the other hand, shortage of materials can lead to interruption of products for sales; poor customer relations and underutilized machines and equipments. Inventories may consist of raw materials, work-in-progress, spare parts/consumables, and finished goods. It is not necessary that a company has all these inventory classes. But, whatever may be, the inventory items, need management as, generally, a substantial share of an Organization's funds is invested in them. Different departments within the same organization adopt different attitude towards inventory. For example, the sales department might desire large stock in reserve to meet virtually every demand that comes. The production department similarly would ask for stocks of materials so that the production system runs uninterrupted. On the other hand, the finance department would always argue for a minimum investment in stocks so that the funds could be used elsewhere for other better purposes, (Vohra, 2008:427). Inventory represents an important decision variable at all stages of product manufacturing, distribution and sales, in addition to being a major portion of total current assets of many organizations.

The procurement function is responsible for managing the purchasing activity for the company (Lysons, 2012). There are two types of purchasing or procurement departments: centralized and decentralized. In a centralized model, all requests for materials or goods are center to this department. In a decentralized model, individual departments can process their own purchases. Regardless of the organizational model used procurement is subject to more scrutiny and review than any other process. The use of company resources to purchase goods and services must be based on adherence to specific policies and procedures to reduce the chance of fraud and theft. The main purpose of the procurement function is to manage the process used for the purchase of goods and services by the organization. Inventory Management encompasses processes that ensure product availability while reducing investment costs (Krautter, 2009; Schroeder, 2000). For most companies, there are two forms of inventory: Physical and Logical. Physical inventory includes all the materials that are tangible and required to fabricate the final product (Toomey, 2000). On the other hand, examples of logical inventory are databases, inventory tracking

software, et al. Proper synchronization of these two inventories is essential for proper management of company assets. Inventory management also involves identifying the most effective source of supply for each item in each stocking location. Forecasting and replenishment are also integral to inventory management.

Koumanakos (2008) studied the effect of inventory management on firm performance 1, 358 manufacturing firms operating in three industrial sectors in Greece, food textiles and chemicals were used in the study covering 2000 – 2002 period. The findings suggested that the higher the level of inventories preserved by a firm, the lower the rate of return. Agus and Noor (2006) did measure the perception of managers about the impact of inventory management practices on financial performance of manufacturing firms in Malaysia. However, circumstances in Malaysia could be different from those in Kenya.

In the past, inventory management was not seen to be necessary. In fact excess inventories were considered as indication of wealth. Management by then considered over stocking beneficial. But today firms have started to embrace effective inventory management (Susan & Michael, 2000). Managers, now more than ever before, need reliable and effective inventory control in order to reduce costs and remain competitive (Closs, 1989). According to Dobler and Burt (2006), inventory alone account for as much as 30% of the organization invested capital. It's for this reason that the Government of Kenya through its Supplies manual (2007) instituted procedures and techniques for the purpose of effective inventory management.

There are 3 sugar belts in Kenya, namely the Nyando, the Western sugar belt and the South Nyanza sugar zone. The western sugar belt occupies the western part of Kenya formerly the western province of Kenya in the counties of Kakamega, Bungoma and Busia. The sugar manufacturing companies in the Western Sugar belt are Mumias sugar company, West Kenya Sugar Company, Nzoia Sugar Company and Butali Sugar Mills. Mumias Sugar Company Limited is the largest sugar manufacturer in Kenya producing about 250, 000 metric tonnes (42%) of the estimated 600, 000 metric tonnes annual national output. The company maintains is located in the town of Mumias, in Kakamega County, near the sugar plantations.

West Kenya Sugar Company Limited is the fastest growing sugar company in Kenya located in Shamberere along the Kakamega –Webuye road in Kakamega County. West Kenya, the second largest sugar producer in the country after Mumias, crushes 3,000 metric tonnes of raw cane daily. Nzoia Sugar Company Limited is one of the key players in Kenya's Sugar Industry. Nzoia Sugar Company is located in Bungoma County. The company serves over 67, 000 farmers in the larger Bungoma, Kakamega, Lugari and Malava Districts. Butali Sugar Company is an ultra modern sugar factory within the heart of Kakamega County in the Western part of Kenya. The company is set in a rural peasant community. Its major objective is to promote and represent the interests of sugarcane farmers within the Butali sugar zone in the larger Western sugar belt.

A study on the effect of inventory management on performance of the procurement function of sugar manufacturing companies cannot be overlooked. Problems of inventory management and control in the procurement function have been around for a very long time. We usually think of stocks being

held by organizations to allow efficient and continuous operations. Procurement managers are aware of the vital roles inventory plays in the activities of the purchasing function in organizations. Effective inventory management is essential in the operation of any business (Bassin, 2014). It is therefore very important for the procurement function in a company to successfully manage their inventory and use all techniques that they see fit for their type of business. By doing this they can lower overhead costs and increase their customer satisfaction by having goods available when the customer demands them thus improving the performance of their procurement function. Both Physical and Logical inventory needs to be assessed and managed in a way in which the information is true and accurate so that there is no overstocking and minimal shortages are realized. Good inventory management by the procurement function also means having accurate forecasting and accurately timed replenishments (Onwubolu & Dube, 2006). In most companies, inventories represent up to 50% of the total product cost, the money entrusted on inventory, thereby affecting the performance of the procurement function and the overall performance of the company.

Sugar manufacturing companies do not manage and control their inventory holding, resulting in under stocking of the cane causing the companies to stay off production and stock outs of the sugar thereby resulting to poor performance of the procurement function. This therefore creates relationship problems between inventory management and the performance of the procurement function. The inventories under study are the raw materials: cane and the finished goods: sugar. The aim of this study will be to establish the effect of inventory management on the performance of the procurement function of sugar manufacturing companies in the western sugar belt.

The general objective of this study was to examine the effect of inventory management on the performance of the procurement function of sugar manufacturing companies in the western sugar belt. The specific objectives were to establish the significance of a lean inventory system on the performance of the procurement function of sugar manufacturing companies in the western sugar belt, to find out how strategic supplier partnerships in inventory management affects the performance of the procurement function of sugar manufacturing companies in the western sugar belt, to investigate the effect of information technology in inventory management on the performance of the procurement function of sugar manufacturing companies in western sugar belt and to examine the effect of the legal policies on inventory management in the sugar industry on the performance of the procurement function of sugar manufacturing companies in the western sugar belt.

The findings of the study on the effect of inventory management on the performance of the procurement function of sugar manufacturing companies will be quite significant since it is hoped that it will provide sugar manufacturing companies with a better understanding of inventory management and its relationship to the performance of the procurement function.

The findings will assist the management of sugar manufacturing companies in Mumias, West Kenya, Nzoia and Butali sugar mills in ensuring effective inventory management at all times as it will aid those entrusted with decision making to formulate strategies of combating the persistent problem of

inventory control and better performance of the procurement function in the sugar manufacturing companies. Inventory management will result to prudent utilization of resources resulting to improved services to the stakeholders by the procurement function. This will improve the economy of the country and also improve the people's standard of living. The researcher will not only fulfill the partial requirement for the award of a degree of Masters of Science in Procurement and Logistics but will also serve as a basis for further research in the field of inventory management in relation to the performance of the procurement function.

The research focused on the effect of inventory management on performance of the procurement function of sugar manufacturing companies in the Western sugar belt. The study involved procurement officers of Mumias Sugar Company, West Kenya Sugar Company, Nzoia Sugar Company and Butali Sugar Company.

II. LITERATURE REVIEW

2.1 Theoretical Framework

This will give an evaluation of the research by other scholars and will help make logical sense of the relationship between inventory management and the performance of the procurement function in sugar manufacturing companies.

2.1.1 Economic Order Quantity Theory

Economic order quantity is the cost of inventory that minimizes the total cost of inventory management. Dave Plasecki (2001) defines Economic Order Quantity as an accounting formula that determines the point at which the combination of order costs and inventory costs are the least. Economic order quantity is the number of units that a company should add to inventory with each order to minimize the total cost of inventory, such as holding costs, ordering costs and stock out costs. EOQ is used as part of continuous review system in which the level inventory is monitored at all times and fixed quantity is ordered each time the inventory reaches a specific reorder point (Lysons, 2012). Muckstadt et al., (2010) discussed that EOQ model was determined by minimizing the total annual cost incurred by the company by virtue of its ordering cost and carrying cost. The expression for total annual cost is:

$$TC = \frac{q}{2} h + \frac{D}{Q} s$$

Where,

TC=total annual cost

Q=order quantity

D=annual demand

S=ordering cost

H=annual carrying cost per unit

Muckstadt et al., (2010) also said that the first component of this equation represented the inventory management costs and the second component represents the ordering cost. EOQ minimizes the sum of holding and setup costs. Differentiating with respect to order quantity, the expression for EOQ was obtained as indicated in the equation below. $Q = \sqrt{2DC_o/C_h}$

D = annual demand

C_o = ordering/setup costs

C_h = cost of holding one unit of inventory

2.1.2 Resource Dependency Theory

According to resource dependence theory (RDT), firms seek to reduce uncertainty and manage dependence by purposely structuring their exchange relationships, establishing formal and semiformal linkages with other firms. Through interdependence, firms can synergistically combine their own resource sets with the complementary resources of their partners and thus develop a resource bundle that is unique and hard to imitate (Harrison *et al.*, 2001). By cultivating such relationship-specific capabilities that become superior to what the organizations may possess on their own firms can obtain sustainable competitive advantage and improved procurement performance (Sambharya & Banerji, 2006; Paulraj & Chen, 2007). In this aspect, RDT is a relevant theory to SCM because it can help elaborate organization-environment boundary spanning activities, implying that a single firm can hardly achieve sustainable growth. Therefore, firms need to depend on the buyer-supplier relationship which helps improve cooperation and coordination among supply chain members (Dyer, 2000).

For SCM to be strategic in nature, it is imperative that buyer firms adopt strategic initiatives, that is, implementation of GSCM practices that foster an effective relationship to provide mutual benefits (Paulraj & Chen, 2007). In the context of GSCM, inter-organizational collaboration is even more important for managing the internal and external coordination and cooperation to have the system successfully implemented throughout the whole supply chains (Zhu *et al.*, 2010). Handfield *et al.* (2002) developed a decision model to measure environmental practice of suppliers using a multi-attribute utility theory approach. Kainuma and Tawara (2006) proposed the multiple attribute utility theory method for assessing a supply chain including re-use and recycling throughout the life cycle of products and services.

2.2 Conceptual Framework

The conceptual framework for this research brings forth the independent and dependent variables of the study. The independent variables are the variables that I will manipulate in order to determine their effect or influence on the dependent variable. They will help me predict the amount of variation that occurs in the dependent variable (Kothari, 2008). The value of the dependent variable depends on the independent variables. The independent variables will include: lean inventory system, strategic supplier partnerships, information technology and the legal policies on inventory management in the sugar industry. The dependent variable is the performance of the procurement function of sugar manufacturing companies in the western sugar belt. The relationship between independent variables and the dependent variable is of profound importance as it will clearly stipulate the effect of inventory management on the performance of the procurement function of the sugar manufacturing companies in the western sugar belt in Kenya.

2.2.1 Lean Inventory System

Lean production principle was pioneered by Womack et al (2003). This principle was linked with reduced inventories. The argument is that as inventory is reduced there will be profit improvement due to interest savings as well as a reduction in storage fees, handling and waste. These savings have been estimated by literature to be in the range of 20 -30 percent

(Brigham & Gapenski, 2010). Lean Management is getting more and more attention in today's highly competitive environment. The proponents of Lean Inventory system argue that excess inventory will adversely affect the net cash flows of a firm. On the cost side, most obvious are the costs of holding inventory, which include the capital costs (interest or opportunity) and the physical cost (storage, insurance and spoilage). In recent years, a number of systems have been developed in the field of operations management to deal with excess inventory problem. Management-oriented systems include the Just-In-Time (JIT) and Materials Requirements Planning systems (MRP).

Just-In-Time refers to a collection of practices that eliminate waste. These organization wide practices encompass the entire supply chain. The elements of JIT include shared product design with suppliers and customers, movement towards single sourcing proximate suppliers, reduced machine set-up times and total preventive maintenance. It is an inventory strategy that is implemented to improve the return on investment of a business by reducing inventory and its associated carrying costs. In order to achieve JIT, the process must have signals of what is going on everywhere within the process. JIT can lead to dramatic improvements in a manufacturing organization's return on investments, quality and efficiency. It emphasizes that production should create items that arrive when needed, neither earlier nor later.

Quick communication of the consumption of old stock, which triggers new stock to be ordered, is key to JIT and inventory reduction. This saves warehouse space and costs. The basic philosophy of JIT is that inventory is defined as waste. The technique was first used by Ford motor company. It was subsequently adopted and publicized by Toyota Motor Corporation of Japan in the 1950s.

MRP system is defined as product-oriented computerized technology aimed at minimizing inventory and maintaining delivery schedules. It relates the dependent requirements for materials and components comprising an end product to time periods over planned horizon on the basis of forecasts provided by marketing and sales and other input information (Lysons and Gillingham, 2003). This system is based on the recognition that demands for an item may be dependent on the demand for other inventory items. The emphasis is on the end product into which related parts are incorporated. The inventory quantities required are specified on the basis of future demand. The demand for inventory items is precisely determined from the master production schedule for the end products. The operation of a lean inventory system such as JIT and MRP result in relatively low inventory levels. The warehousing costs and material handling costs are significantly reduced. This increases return on assets through decreased conversion costs.

2.2.2 Strategic supplier partnerships

Lysons and Gillingham (2003) define strategic partnering as a commitment by both customers and suppliers, regardless of size, to a long term relationship based on clear, mutually agreed objectives to strive for world class capability. The emphasis is on good working relations between customers and suppliers. The concept of strategic supplier partners developed strongly in the 1980s as a result of the movement towards just-in-time (JIT) manufacturing. JIT emphasizes reduction in waste, shortening of

lead times, improvement and simplicity. These are also the goals of strategic supplier partnerships (Bicheno, 2004). The philosophy is that through co-operation rather than confrontation both parties benefit. In strategic partnership, long term relationships are sought rather than short term and adversarial relations. The contracts are long term in order to give the supplier confidence and the motivation to invest and improve. For partnership to work, proper communication is an important factor. The suppliers and customers who communicate clearly and directly are judged to be more effective. Personal connections with supplier's representatives remain important despite the increasing use of electronic communication of all kinds. There is also need to embrace the principle of early supplier involvement in design. This reduces the chances to defective items and the risk of obsolescence because the supplier is involved in the design process (Brownell, 2005).

Vendor Managed Inventory (VMI) is a new feature of supplier partnerships. In a VMI relationship, the supplier holds inventory on site or near the customer, allowing the customer's instant access to the inventory. This immediate access allows the customer to pull inventory as needed and only pay for that which is consumed, thus reducing inventory investment and increasing inventory turns. In VMI arrangements the supplier has a responsibility for replenishing stock, which would include ordering, managing the logistics to ship the material and counting inventory. By passing these costs normally managed by the customer on the supplier, the customer is able to reduce the overall cost of their product and increase their margins. The supplier benefits from a higher share of the purchaser's total purchase requirements (Loughrin, 2008).

According to Lambert (2006) supplier relationship management is the process that defines how a company interacts with its suppliers. Just as a company needs to develop relationships with its customers, it also needs to foster relationships with its suppliers. As in the case of customer relationship management, a company will forge close relationships with a small subset of its suppliers, and manage arm-length relationships with them. A Product and Service Agreements (PSA) is negotiated with each key supplier that defines the terms of the relationship. For segments of less critical suppliers, the PSA is not negotiable. Supplier relationship management is about defining and managing these PSAs. Long-term relationships are developed with a small core group of suppliers. The desired outcome is a win-win relationship where both parties benefit. According to Kandampully, 2003, the global business environment has reached a point where firms cannot compete as individual firms but as a network. This network has to be well organized so that competitive advantage can be gained. (Borgatti&Foster, 2003), concurs with the latter indicating that shifts have occurred in the business environments with firms moving from standing alone to working with others as a way of enabling better performance. Moreover, studies that have been in the fields of marketing, supply chain management and international management all reflect the importance of such relationships terming it as economic boosters (Nagurney, 2010) as well as a means of bettering the firm's success and performance (Veludo, Macbeth & Purchsae, 2006). Supply chains are prone to uncertainties due to delayed deliveries,

machine breakdowns and machine fluctuations which necessitate increased inventories

2.2.3 Information Technology

Carter and Price (2010) assert that information is the life blood of all organizations. An Inventory manager needs information technology in order to succeed in his work. Computers can assist in stock control in calculating the optimum amount of stock to hold and dispatch in order to satisfy the user requirements. The computer can do this by comparing inventory variables (stock levels, demand and delivery dates). The Electronic Data Interchange, EDI is a system which enables direct communication between organizations without there being any human intervention. This technology has revolutionized inventory management. EDI is the name given to the transmission and receipt of structured data by the computer systems of trading partners, often without human intervention. The international Data interchange association defines EDI as "the transfer of structured data, by agreed message standards from one computer system to another, by electronic means (Jessop, 2006). With the EDI system linking the buying organization with its suppliers, the replenishment can be triggered at the instant the need arises and the message is transferred from the original destination without further possibility of corruption en route.

An EDI link also enables the computers of suppliers and customers to interrogate each other about stock levels, production plans and similar information so that activities are appropriately synchronized. This brings potential benefits in form of reduced paper work, greater accuracy of information, reduced staff costs and shorter lead times arising from instantaneous communication.

Electronic point of sale, EPOS is another technology used in inventory management. The purpose of EPOS is to scan and capture information relating to goods sold. An EPOS system verifies checks and provides instant sales reports, charges transactions and sends out intra- and inter- stores messages. The EPOS technology allows substantial cost savings and gives "real time" information on sale of goods, patterns of stores traffic, and popularity and profitability of every line carried. It enables stock to be limited to demand, reduces the risk of obsolescence and deterioration of stocks, reduced chances of theft and provides information to buyers. This leads to improved customer service and hence improved financial performance (Lysons, 2012).

2.2.4 Legal policies

The Kenya Sugar Board (KSB) is the regulatory body of the Sugar Industry in Kenya. The mandate of the Kenya Sugar Board as stipulated in Section 4 (1) and 4 (2) of the Sugar Act 2001 is as follows: regulate, develop and promote the Sugar Industry; co-ordinate the activities of individuals and organizations within the industry; Facilitate equitable access to the benefits and resources of the industry by all interested parties. The Kenya Sugar Board is charged with the responsibility of regulating, developing and promoting the Kenya Sugar Industry. Its specific roles are to: Co-ordinate the activities of individuals and organizations within the industry; Facilitate the equitable access to the benefits and resources of the industry by all interested parties; Formulate and implement overall policies and plans for

the development of the industry; Act as an intermediary between the Government and the industry; Facilitate the flow of research findings to interested parties; Monitor the domestic market in order to identify and advice on any distortions in the sugar market; Facilitate the arbitration of disputes among interested parties; Facilitate the export of Local sugar; Promote and encourage the use of environment friendly technologies in the industry; Provide advisory services to growers and millers; Facilitate an equitable mechanism for the pricing of sugar-cane and appropriation of proceeds from the disposal of the by-products of sugar production between growers and millers; Represent the industry in other organizations that are relevant to the promotion of the industry; Oversee the formulation of standard provisions governing the mutual rights and obligations of growers and millers; Collect and analyze industry statistics and maintain a database for the industry; and promote the efficiency and development of the industry through the establishment of appropriate institutional linkages.

The service delivery of the Kenya Sugar Board include: Competitiveness: They are committed to engaging in practices that ensure competitiveness in a global setting; Teamwork: In order to meet their goals, they practice teamwork to optimize the synergies of individual and collective human resources, talent and capacity; Integrity: They uphold virtues of integrity through honesty, confidentiality and fairness in discharging their responsibilities; Efficiency: With highly motivated staff, they ensure optimum utilization of all resources available to deliver quality and timely services to all their stakeholders; Accountability: They endeavor to manage the resources entrusted to them in a professional and transparent manner; Social Responsibility: They endeavor to be socially responsible to their stakeholders and society and pursue their goals through socially acceptable practices that preserve the environment, promote socio-economic development and add value to our country.

The Public Procurement Oversight Authority oversees all the procurement activities in public entities. It was created in 2005 under the Public Procurement and Disposal Act was enacted. It is mandated with the responsibility of ensuring that all procurement procedures established under the Act are complied with, monitoring the procurement system and reporting its overall functioning, initiating public procurement policy and assisting in the implementing and operation of the public procurement system (PPOA, 2008). Public entities should draft procurement policies that are compatible with procurement regulations and all employees should be made aware of the formulated policies. The PPOA directives should be put in mind while formulating procurement policies.

2.2.5 Performance of the procurement function

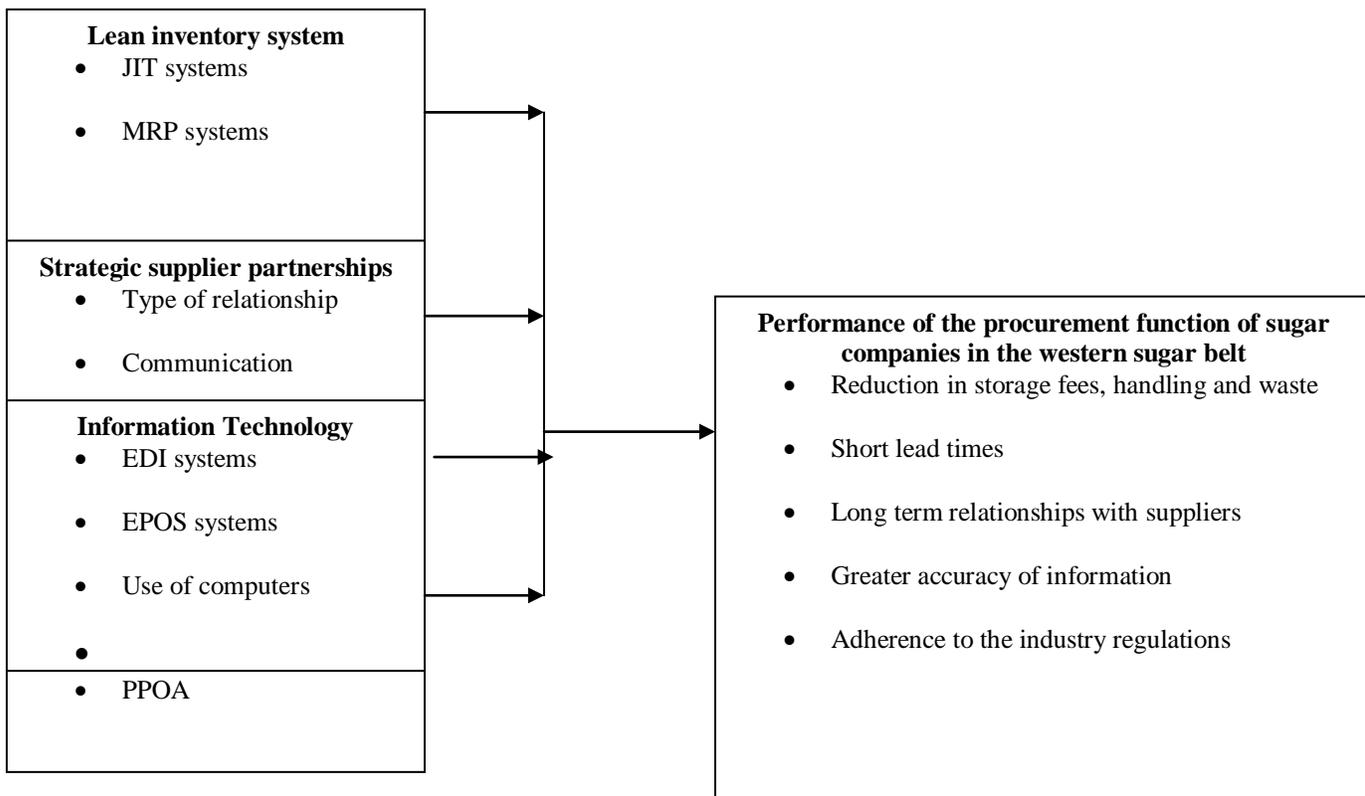
Inventory Management is very vital in the performance and growth of the procurement function in a company. The entire profitability of an organization is tied to the volume of products sold which has a direct relationship with the quality of the product. The procurement function does a lot to present a good company to the public in terms of quality production. Good inventory management in any manufacturing organization saves the organization from poor quality production, disappointment of seasoned customers, loss of profit and good social responsibility, (Johnson, 2008). This is done by ensuring timely delivery of raw

materials to the factory and distribution of finished goods. If inventory management is not adequately maintained, production cannot meet the aspirations of customers which are loss of revenue to the organization. Right from procurement to the time of processing, quality of raw material is the chief determinant of the productive efficiency of any manufacturing concern.

Lawson (2008), views that the most effective measurement systems assess performance in the entire length of the Organization's procurement function, from suppliers through internal processes to customers. The measures are divided in five major categories which include cost measures, quality measures, time measures, supplier performance measures and customer satisfaction measures. The metrics that are used in performance measurement should be those that truly capture the essence of the

procurement function performance. A measurement system should facilitate the assignment of metrics to where they would be most appropriate. For effective performance measurement, measurement goals must represent the goals of the function and metrics selected should reflect a balance between financial and non-financial measures that can aid in decision making.

The performance of the procurement function encompasses the financial performance and market performance. Business profitability is a justification of its good performance and loss is a justification of poor performance. Profits are an indication of good performance. A higher percentage of the return on assets shows how profitable a company's assets are generating revenue.



Independent variables

Dependent variable

Fig. 2.1 Conceptual Framework

2.3 Empirical Review

An important factor in inventory management relates to production scheduling. Continuous process manufacturers often produce a mix of products, one at a time, using the same equipment and facilities. Each time a different product is to be produced, it is necessary to stop the production process and make adjustments before proceeding (Ritzman et.al, 2003).

The costs of shutdown and adjustments, which are referred to here as changeover costs, can be rather high. Production time is lost while the facilities are closed down, and labor costs must be expended to make the necessary adjustments (Ritzman et.al, 2003). As a consequence of the changeover costs, businesses try

to find ways to minimize the number of changeovers. One of the principle ways of achieving this goal is through the use of inventory. Simply put, a company can choose to make many short production runs on each product in the mix, thereby incurring many changeovers and having smaller lots in inventory or it can opt for long production runs and very few changeovers and increasing inventory lots.

In 1880 there was a change in manufacturing practice from companies with relatively homogeneous lines of products to horizontally integrated companies with unprecedented diversity in processes and products. Those companies (especially in metalworking) attempted to achieve success through economies

of scale- the gains of jointly producing two or more products in one facility. The managers now needed information on the effect of product-mix decisions on overall profits and therefore needed accurate product-cost information. A variety of attempts to achieve this were unsuccessful due to the huge overhead of the information processing of the time (Wagner, 2002). However, the rapidly increasing need for financial reporting after 1900 created unavoidable pressure for financial accounting of stock and the management need to cost manage products became overshadowed. In particular, it was the need for audited accounts that sealed the fate of managerial cost accounting. The dominance of financial reporting accounting over management accounting remains to this day with few exceptions, and the financial reporting definitions of 'cost' have distorted effective management 'cost' accounting since that time. This is particularly true of inventory (Saxena, 2009).

Inventory management entails holding an appropriate amount of inventory. Too much inventory consumes physical space, creates a financial burden, and increases the possibility of damage, spoilage and loss. On the other hand, too little inventory often disrupts business operations, and increases the likelihood of poor customer service (Dimitrios, 2008). Inventory as an asset on the balance sheet of companies has taken on increased importance because many companies are applying the strategy of reducing their investment in fixed assets, like plants, warehouses, equipment and machinery, and so on, which even highlights the significance of reducing inventory (Coyle et al., 2003). Changes in inventory levels affect return on assets (ROA), which is an important financial parameter from an internal and external perspective. Reducing inventory usually improves ROA, and vice versa if inventory goes up without offsetting increases in revenue (Coyle et al., 2003).

Lean production/manufacturing is also an important consideration in improving the performance of the procurement function. Sanches and Ferez (2001) also investigated the link between lean production practices in manufacturing organizations and resultant enhanced competitiveness. Lean production is also expected to improve the performance of the firms through good housekeeping practices, such as general waste reduction and minimizing hazardous wastes. King and Lenox (2001) conclude that lean production is complementary to improvements in the performance of the procurement function and it often lowers the marginal cost of pollution reduction thus enhancing competitiveness.

2.4 Critique of the existing literature relevant to the study

The reviewed literature would suggest that the area of inventory management and the performance of the procurement function has not been fully studied or the area is marred with problems as the authors present it but at the same time it is clear that inventory management is key to the financial and non-financial performance of the procurement function of a company (Goldsby et al., 2005; Krautter, 2009; Schroeder, 2000). A few of the authors (Lambert, 2006) also seem to take the relationship between inventory management and the performance of the procurement function as a simple task of which it may not be the case always in some manufacturing companies.

2.5 Research Gaps

The gap remains as to how inventory management can be for it to guarantee the performance of the procurement function in any given manufacturing company. At the same time some scholars have suggested that procurement managers who turn to inventory theory research may find it to be of little significance (Krautter, 2009) or that it has little to offer in terms of enhancing inventory practices (Wagner, 2002) in the procurement function. This has led many to suggest a gap exists between inventory theory and practice as regards the procurement function (Wagner, 2002). While the varied solutions offered to bridge this gap represent valuable research, input from practitioners is noticeably absent. Therefore, an empirically derived agenda founded on practitioners identified issues that need to be researched on (Vigoroso, 2005). There is no study that has been comprehensively done on the effect of inventory management on the performance of the procurement function of manufacturing companies and hence the study intends to fill that gap.

2.6 Summary

Schroeder (2000) established that there are three motives for holding inventories, which are transaction, precautionary and speculative motives. Lyson (2006) states that inventory serves as an insurance policy against the unexpected breakthrough, delays and other disturbance that could disrupt ongoing activities. According to the review, overstocking, poor supplier relationships and poor utilization of information technology are some of the factors that limit inventory management thus influencing the performance of the procurement function. Dobler and Burt (2006) emphasized that stock represents money and similar control measures should be taken on stock as it is the case of cash. It is important to have a good inventory system as it helps in preventing stock outs, overstocking, deterioration, obsolescence and high carrying cost. A sound inventory management system is therefore vital for decision making in the procurement function and the company as a whole. Strategic supplier relationships, a lean inventory system and effective use of information technology are important to a company which expects its procurement function to operate efficiently and offer quality services.

III. RESEARCH METHODOLOGY

The researcher utilized a descriptive survey research design as permitted an in- depth investigation of the problem under study (Yount, 2006). The design accurately describes an association between variables minimizing bias and maximizing the reliability of the data (Kothari, 2004). Questionnaires were distributed to the respondents for collecting relevant data to the study. The research study targeted all the 100 procurement officers in the procurement function of Mumias sugar company, West Kenya sugar company, Nzoia sugar company and Butali sugar mills. The study will use a survey and a sample of 30 procurement officers out of the total population was obtained using simple random sampling method. The study used simple random sampling method in selecting the respondents.

The study applied simple random sampling procedures to obtain the respondents for the questionnaires in the sugar companies that are in the western sugar belt. The sample frame of the study included a representative sample of the individuals

working in the procurement function. At least 30% of the total population is a representative (Borg & Gall, 2003). Thus, 30% of the accessible population is enough for the sample size in this study. Out of the 100 procurement personnel in the four sugar companies in the western sugar belt, the researcher took 30% of the total population which was 30 procurement personnel. Thus $30/100 * 100 = 30$

Therefore 30 procurement personnel from the four sugar companies were the respondents. 7 respondents from each company were issued with questionnaires. The study relied on primary data. Structured questionnaires were developed and administered to the respondents who indicated their responses in the spaces provided. Structured questionnaires were used since they are simple to administer and will eased the data analysis process (Barnes, 2001)

Reliability was tested using Cronbach's alpha scores. Principal factor analysis was used to determine the content validity of the instrument. The tabulated data was subjected to both quantitative and qualitative analysis. Quantitative data analysis was helpful in data evaluation because it provided quantifiable and easy to understand results. Qualitative data analysis, on the other hand helped the researcher to gain in-depth understanding of the research findings. Quantitative data was analyzed through descriptive statistics in the form of frequencies tallies and percentages. The statistics were generated using statistical package for social sciences (SPSS) and data obtained was communicated through pie charts and tables. Qualitative data was analyzed by organizing them in accordance with the research questions and objectives. After the analysis, the data was presented in tables and charts and recommendations and conclusions made.

IV. DATA PRESENTATION AND FINDINGS

The data is presented in form of tables and pie charts where necessary and they are in line with the research design and the objectives of the research.

4.1 Result of the pilot study

The study involved a random selection of 3 procurement personnel from 2 sugar manufacturing companies each. The findings are recorded below. The findings are recorded in the table below

Table 4.1: Result of the pilot study

Variables	Cronbach's
Lean inventory system	0.701
Strategic supplier partnerships	0.769
Information technology	0.731
Legal policies	0.720

The findings of the pilot study in table 4.1 showed that the use of lean inventory systems had a Cronbach's reliability value of 0.71. Strategic supplier partnerships had a reliability alpha value of 0.769. Information technology had a reliability alpha value of 0.731 and the legal policies had a reliability alpha value of 0.720.

4.2 Background Information

4.2.1 Response rate

Table 4.2: Response rate

Population	Frequency	Percentage
30	26	87% 100%

From table 4.2, the response rate was 87%. Mugenda & Mugenda 1999, states that a response rate of 60% is good, and above 70% is perfect. Since the response rate is 87%, it is excellent.

4.2.2 Age of respondents

The study sought out the age of the respondents who were the procurement personnel in the sugar manufacturing companies within the Western sugar belt. The findings were recorded in figure 4.1.

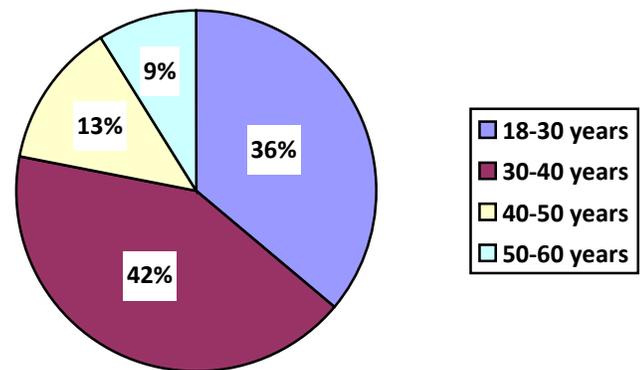


Figure 4.1: Age of the respondents

From the findings in figure 4.1, 42% of the respondents were aged between 30-40 years, 36% were aged between 18-30 years, 13% were aged between 40-50 years, and 9% were aged between 50-60 years.

4.2.3 Years of service

The study sought to know the length of time the respondents have worked at their hospitals as this helped in determining their experience and knowledge of the hospital. The findings are indicated in figure 4.2.

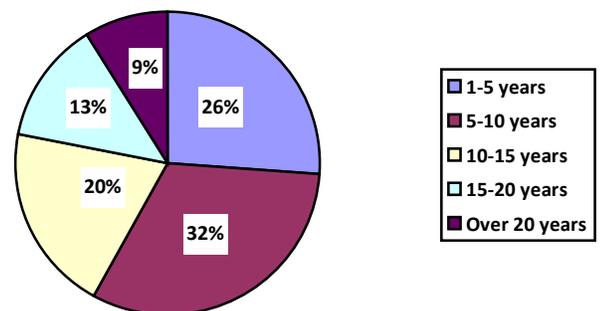


Figure 4.2: Years one has worked at the sugar manufacturing company

From the findings in figure 4.2, 32% of the respondents had worked in their companies for between 5-10 years, 26% had worked for between 1-5 years, 13% had worked for between 15-20 years and 9% had worked for over 20 years.

4.2.4 Highest Level of Education

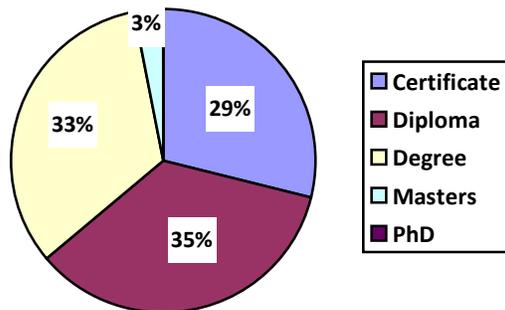


Figure 4.3: Highest level of education

From the finding in Figure 4.3, 35% of the respondents were Diploma holders, 33% were Degree holders, 29% were Certificate holders and 3% were Masters holders and none of the respondents was a PhD holder.

4.3 Lean Inventory system

The first objective of the study was to establish the significance of a lean inventory system on the performance of the procurement function of sugar manufacturing companies in the western sugar belt. The results are recorded in the pie chart and the tables.

Table 4.3: Inventory system in use

Inventory system in use	Response (%)	
Manual	40%	100%
MRP	47%	100%
Barcode	10%	100%
Others	3%	100%

From table 4.3, it was found out that MRP systems are the most used inventory management systems at the sugar manufacturing companies with a percentage of 47%, manual systems came second with a percentage of 40%, use of barcodes 10% and other systems like the use of spreadsheets had 3%. The findings are in line with the findings of Timothy L, Patrick O and Nebat M (2013) that MRP is the most widely used system in inventory management because all the sugar manufacturing companies have to prepare master production schedules, with accurate bills of materials which are key elements in the MRP system. This shows that the sugar manufacturing companies have employed lean inventory systems to some extent.

Table 4.4: Use of lean inventory systems.

Statement	Yes	No	100%
Do you support the use of lean inventory system in your company?	87%	13%	100%

From table 4.4, it was found out that 87% of the respondents support the use of lean inventory systems whereas 13% were not in support of lean inventory systems. The findings are in line with the findings of Fahey (2004) that the use of lean inventory systems has a positive receipt among employees of manufacturing companies.

Table 4.5: How inventory levels can be reduced

Statement	Response	
Improve supply chain management	11%	100%
Re-engineer inventory control processes	28%	100%
Improve production scheduling	33%	100%
Develop flexible manufacturing	7%	100%
Utilize "pull" based on demand	3%	100%

From the finding in table 4.5, 33% of the respondents suggested that inventory levels can be reduced through production scheduling, 28% through re-engineering of inventory control processes, 11% by improving supply chain management, 7% by developing flexible manufacturing and 3% by utilizing “pull” based on demand. The findings support the findings of Herrmann (2006) that improving production scheduling can help reduce inventory levels in manufacturing companies.

4.5 Strategic supplier partnerships

The second objective of the study was to find out how strategic supplier partnerships in inventory management affect the performance of the procurement function of sugar manufacturing companies in the western sugar belt.

Table 4.6: Relationship with suppliers

Statement	Long term	Short term
What is the nature of your company’s relationship with its suppliers?	36%	64% 100%

From table 4.6, 64% had a short term relationship with their suppliers whereas 36% had a long term relationship with their suppliers. This implies that the sugar manufacturing companies are yet to adopt the new concept of VMI which would ultimately transfer the responsibility of inventory management from the procurement functions of the companies to the suppliers and

hence substantially improve on the performance of the procurement function. This new concept dictates a long term relationship with a supplier which is not the case in the sugar manufacturing companies.

Table 4.7: Supplier appraisal

Statement	Yes	No
Do you appraise your suppliers?	29%	70% 100%

From table 4.7, 29% of the respondents said that their companies appraise suppliers and 71% said that their companies do not appraise their supplies. The findings support the works

Alphonse (2015) that supplier appraisal has not been taken up fully by Kenyan retailers.

Table 4.8: Communication with suppliers

Statement	Response (%)	
Monthly	8%	100%
Once in every 3 months	12%	100%
Twice a year	23%	100%
Once a year	57%	100%

From table 4.8, it was established that 57% of the respondents communicate with their suppliers once a year, 23% twice a year, 12% once in every 3 months and 8% communicate with their suppliers monthly. This implies that most sugar manufacturing companies are not keen in communicating with their suppliers frequently. They mostly communicate with their suppliers once a year during their annual general meetings.

4.6 Information Technology

The third objective of the study was to investigate the effect of information technology in inventory management on the performance of the procurement function of sugar manufacturing companies in the western sugar belt. The findings are recorded in table 4.9.

Table 4.9: Use of Information Technology

Statement	Response	
Is inventory management automated in your company?	Yes (31%)	No (79%)
Is the procurement staff well trained on the use of Information Technology applications in inventory management?	Yes (11%)	No (89%)

The findings in table 4.9, a small percentage of 31% show that inventory management is automated in the sugar manufacturing companies and 79% show that inventory management is not automated in the sugar manufacturing companies in the western sugar belt. This shows that sugar manufacturing companies have to some small extent adopted the use of Information Technology in inventory management. They have automated some of their inventory management systems. Christopher (2005) asserts that the use of information

Technology in inventory management is more efficient than the use of manual systems.

4.7 Legal policies

The fourth objective of the study was to examine the effect of the legal policies on inventory management in the sugar industry on the performance of the procurement function of sugar manufacturing companies in the western sugar belt. The results are recorded in the charts and the tables.

Table 4.10: Legal policies

Statement	Yes	No	
Are you familiar with the public procurement policies and the role of the Kenya sugar board in the sugar industry?	43%	57%	100%

From table 4.10, it was established that 57% of the respondents were not familiar with the legal policies in place and the role of the Kenya Sugar Board. 43% of the respondents were familiar with the legal policies and the role of the Kenya Sugar Board. The findings imply that a greater percentage of the respondents are not familiar with the laws guiding the procurement procedures and the legal framework of the sugar industry in Kenya.

management activities affected by the legal policies in place?

Table 4.11: Effect of the legal policies on inventory management activities

Statement	Yes	No	
Are the inventory	49%	51%	100%

From table 4.11, it was established that 51% of the inventory management activities in the procurement function of sugar manufacturing companies in the western sugar belt are not affected by the legal policies in place and 49% of the inventory management activities are affected by the legal policies in place.

Table 4.12: The role of the Kenya Sugar Board

Statement	Response	
Coordinates the procurement and inventory management activities of companies in the sugar industry	Yes (33%)	No (67%)
Acts as an intermediary between the government and the industry	Yes (47%)	No (53%)
Monitors the domestic market to avoid any distortions	Yes (44%)	No (56%)
Provides advisory services to growers and millers	Yes (46%)	No (54%)

From table 4.12, it was established that majority of the respondents are not aware of the role of the Kenya Sugar Board

in the sugar industry yet they work in the sugar manufacturing companies.

4.8 Performance of the procurement function

Table 4.13: Performance of the procurement function

Question	Response	
Does inventory management in your company affect the performance of the procurement function?	Yes (77%)	No (33%)
Do you have any performance measurement procedures in your company?	Yes (29%)	No (71%)
Do reduced inventories improve the performance of your procurement function?	Yes (82%)	No (28%)

From table 4.13, 77% of the respondents agreed that inventory management affects the performance of the procurement function of sugar manufacturing companies and 33% did not agree to that. 82% of the respondents also agreed that reduced inventories affect the performance of the

procurement function and 28% did not agree to that. 71% of the respondents said that they had never seen any performance measurement procedures at their companies whereas 29% said that they had ever seen some performance measurement procedures.

Regression

Table 4.14: Model Summary for all the Variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.826 ^a	.684	.789	.386	1.849

Table 4.14 indicates that the value of the adjusted r squared R2 amount to 0.789 which is 78.9%. This shows that the factors that are not covered amount only to 20.7%. It therefore means that the four factors have a big role to play on the performance of

the procurement function of sugar manufacturing companies in the western sugar belt.

Table 4.15: ANOVA for All Variables

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1646.01130	4	.410	2.727	.000 ^b
Residual	75432.121	5	.149		
Total	77078.1323	9			

The ANOVA result for all variables indicates that there was a highly significant relationship between the variables at F = 2.727 and P = 0.000. This implies that there is a strong relationship between the four variables and the performance of the procurement function of sugar manufacturing companies in the western sugar belt.

improving the performance of the procurement function because it is able to forecast the demand of the raw materials and the consumables.

5.1.2 Strategic supplier partnerships

The study found out that short term relationships with suppliers are adversarial because the procurement function is not keen on frequent communication with the suppliers as well as their appraisal. The poses a challenge to the procurement function of the sugar manufacturing companies when sourcing for suppliers.

5.1.3 Use of Information Technology

The study found out that the use of information technology applications in inventory management improves the performance of the procurement function of sugar manufacturing companies in the western sugar belt because automation of the inventory system helps in reducing errors and waste in inventory

V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Major findings

5.1.1 Significance of a lean inventory system

The study found that improving production scheduling can reduce inventory levels using MRP systems. This helps in achieving lean inventory systems to some extent in the sugar manufacturing companies in the western sugar belt thus

management thus improving the performance of the procurement function.

5.1.4 Effect of legal policies

Legal policies help the procurement function of sugar manufacturing companies in the western sugar belt to manage its inventory and improve its performance because it provides a legal framework to adhere to and guidelines on how to undertake the various procurement activities.

5.2 Conclusion of the Study.

The study found that inventory management affects the performance of the procurement function of sugar manufacturing companies in the western sugar belt. Use of a lean inventory system improves the performance of the procurement function. A strategic relationship with suppliers in inventory management is important in the performance of the procurement function. Finally legal policies in the sugar industry contributed to the performance of the procurement function of the sugar manufacturing companies in the western sugar belt.

5.3 Recommendations for the study

The following are recommendations of the study based on the findings.

5.3.1 Significance of a lean inventory system

The sugar manufacturing companies in the western sugar belt should fully adopt lean inventory systems inventory management as this will greatly improve the performance of the procurement function. JIT systems should also be integrated by the sugar manufacturing companies.

5.3.2 Strategic supplier relationships

Long term relationships with suppliers should be sought by the sugar manufacturing companies in the western sugar belt. The companies should also enhance their communication with suppliers by adopting VMI which will ultimately shift the responsibility of inventory management from the procurement function to the suppliers thus improving the performance of the procurement function. Supplier appraisal by the procurement function should be a key element in inventory management as this will help evaluate the suppliers and choose the best from the many and develop long term round table relationships with them.

5.3.3 Use of Information Technology

Sugar manufacturing companies in the western sugar belt should adopt information technology in inventory management. Automation can help the procurement function in stock control by setting stock control levels and calculating the amount of stocks to hold and dispatch thus improving the performance of the procurement function.

5.3.4 Effect of legal policies

The procurement function of the sugar manufacturing companies in the western sugar belt should adhere to the legal policies in place as they will help the procurement function to manage its inventory and improve its performance because of the legal framework that is provided.

5.4 Areas for Further Study

From the recommendations, it is clear that the effect of a lean inventory system, strategic supplier partnerships, information technology and legal policies in inventory management affects the performance of the procurement function of sugar manufacturing companies in the western sugar belt. I suggest the following areas for further study: lean inventory

systems, legal policies in the sugar industry, IT in inventory management, and strategic supplier partnerships.

REFERENCES

- [1] Barnes, D. (2001), Research Methods for the Empirical Investigation of the Process of Formation of Operations Strategy. International Journal of Operations & Production Management.
- [2] Bicheno, J. (1996). Supplier partnerships. National institute for manufacturing management
- [3] Borgatti, S.P. & Foster, P.C. (2003). The Network Paradigm in Organizational Research: A Review and Typology. Journal of Management.
- [4] Brownell, J. (2005), Strengthening the Purchase Supplier Partnership. A working paper Cornell University
- [5] Carter, R.J., & Price, P.M. (1993). Integrated material management, London: Pitman. International data interchange association
- [6] Dobler & Burt. (2006). Purchasing management. (6th Ed.). McGraw hill international Edition.
- [7] Douglas M. Lambert, (2006). Supply Chain Management: Processes, Partnerships, Performance, Supply Chain Management Institute.
- [8] Goldsby, T., & Martichenko, R. (2005). Lean Six Sigma Logistics: Strategic Development to Operational Success. Boca Raton: J. Ross Publishing, Inc. Government of Kenya, Sugar Act 2001.
- [9] Jessop, D., & Morrison, A. (1994). Storage and supply of materials: (6th Ed). London: Financial Times.
- [10] Kandampully, J. (2003). B2B Relationships and Networks in the Internet Age, Journal Management Decisions
- [11] Kothari, C.R (2008). An introduction to operational Research, New Delhi: Vikas Publishing
- [12] Koumanakos, D.P (2008).The effect of inventory management on firm performance International Journal of productivity and performance Management, Vol 57 (pp 355-369). Emerald Group Publication.
- [13] Loughrin, M. (2008). Lean Thinking and Vendor Managed Inventory. A working Paper University of Liverpool.
- [14] Lenard, J. D., & Roy, B. (1995). Multi-item inventory control: A multi criteria view. European Journal of Operational Research, 87, 685-692.
- [15] Lyson K (2006). Purchasing and Chartered Institute of Purchasing and Supply, London: Pitman Publishing
- [16] Lysons, K., and Farrington, B., (2012). Purchasing and Supply Chain Management, Prentice Hall. London
- [17] Nagurney, A. (2010). Optimal Supply Chain Network Design and Redesign at Minimal Total Cost and with Demand Satisfaction, International Journal of Production Economics.
- [18] Patton, J. D., & Steele, R. J. (1990). Service parts handbook. (2nd Ed.). Rego Park (NY): Solomon Press.
- [19] Plossl, B. (2005), Management, New York: Prentice Hall Inc.
- [20] Schroeder RG 2000. Operations Management- Contemporary Concepts and Cases. USA: International Edition.
- [21] Toomey, J. (2000). Inventory Management principles concepts and Techniques, Kluwer Academic Publisher: Boston
- [22] Veludo, M.de L., Macbeth, D& Purchase, S. (2006), Framework for Relationships and Networks. Journal of Business & Industrial Marketing
- [23] Vigoroso, M. (1999). Buyers Prepare to Brave New World of E-Commerce. Purchasing.
- [24] Vohra, .N.D (2008), Quantitative Techniques in Management New Delhi, Tata Mc Graw Hill.
- [25] Wagner, M.S., Andreas, E. & Eckhard, L. (2010), Creating and Appropriating Value in Collaborative Relationships, Journal of Business Research.
- [26] Womack, J. P., D. T. Jones, and D. Ross, 1990, the Machine that Changed the World. New York: Rawson Associates.
- [27] Yount, R.W. (2006). Research Design and Statistical analysis in Christian Ministry, (4th Ed)

- [28] Zanakis, S. H., Austin, L. M., Nowading, D. C., & Silver, E. (1980). From teaching to Implementing inventory management: Problems of translation Interfaces.

AUTHORS

First Author – Cynthia Mito Mukopi, Master of Science in Procurement and Logistics, Jomo Kenyatta University of Agriculture and Technology.

Second Author – Dr. Amuhaya Mike Iravo, Supervisor, Jomo Kenyatta University of Agriculture and Technology

Factors Influencing the Use of Alternative Methods of Procurement in Public Hospitals in Vihiga County

Laurine Muyuka Mukopi¹, Dr. Amuhaya Mike Iravo²

¹ Master of Science in Procurement and Logistics, Jomo Kenyatta University of Agriculture and Technology

² Supervisor, Jomo Kenyatta University of Agriculture and Technology

Abstract- The study assessed the factors influencing the use of alternative methods of procurement in public hospitals in Vihiga County. Specific objectives guided the research. The first objective determined the influence of public procurement policies on the use of alternative methods of procurement in public hospitals in Vihiga County. The second objective found out how e-procurement affects the use of alternative methods of procurement in public hospitals in Vihiga County. The third objective established the effect of the staff skills on the use of alternative methods of procurement in public hospitals in Vihiga County. The fourth objective determined the effect of funding on the use of alternative methods of procurement in public hospitals in Vihiga County. The literature relating to the study was reviewed and a conceptual framework developed. Descriptive research design, specifically a survey study was employed in carrying out the research. The target population of the study was the people involved in procurement activities in the public hospitals in Vihiga County that consisted of a sample of 35 procurement personnel out of the total target population of 118 procurement personnel from Vihiga County referral Hospital, Sabatia sub county hospital, Hamisi sub county hospital, Luanda sub county hospital, and Emuhaya sub county hospital. The research instrument was a structured questionnaire that was self administered to the respondents. Data was analyzed using SPSS and presented in tables and charts. The response rate was 89%. The ANOVA result for all variables indicated that there was a highly significant relationship between the variables at $F = 2.728$ and $P = 0.000$. This means that there is a strong relationship between the four variables; public procurement policies, e-procurement, staff skills, funding and the use of alternative methods of procurement in public hospitals in Vihiga County.

Index Terms- Public Procurement, E-procurement, Procurement Policies, Direct Procurement

I. INTRODUCTION

A procurement process can only be started after confirmation that funds are available for the procurement and signed approval from the authorizing official has been obtained. Procurement requirements are initiated using a requisition form filled by the user department and submitted to the procurement unit, which then forwards the form to the relevant persons in charge of appending their confirmation signatures, indicating availability of funds and approval for the procurement to proceed (PPDA, 2005).

The main procurement procedure for public hospitals is Open Tendering and the alternative procedures include: restricted tendering, request for proposals, direct procurement, and request for quotations, low value procurement and specially permitted procurement. There are certain factors which help determine which procurement method to use. These factors include, but are not limited to, the estimated value of goods, works or services, the urgency of the requirement and even the limited number of providers. However, procurement must not be split to avoid use of the proper procurement method and should be planned in order to avoid emergency procurement as far as possible (PPDA 2005).

The current financial crisis underlines the centrality of financial resources in the public sector (Kioko et al., 2011). The UK public sector spends over £220 billion annually on the procurement of goods and services (OGC, 2009). The Comprehensive Spending Review in October 2010 saw the UK government embark on a retrenchment of public sector to reduce its significant financial deficit. This demanding environment of austerity increases the saliency of public procurement decision-making and generates an environment for seismic change. The global economic crises that have emerged over the past few years have put tremendous strains on (and remains a challenge for) all the major economies of Europe. Debates about cuts in public spending and increased taxes are taking place now in London, Athens and Paris as they are in most of the European Union capital cities (West, 2012).

The public sector represents about 40-45% of the world's economies; in some African countries it can be as much as 80% (Knight et al., 2007). However, procurement can have a substantial role in achieving this (West, 2012). One initiative taken by the European Union (EU) as part of its plans to tackle the financial crisis is an accelerated public procurement procedure. This initiative should provide a boost to local economies by allowing a more rapid execution of major public investment projects, reducing procurement procedures from 87 days to 30 days. The EU Commission views that speeding up procurement procedures can support member state actions to foster growth in their economies through rapid execution of major public investment projects (European Commission Press Release, 2008). Effective public procurement is seen as a means to which governments reduces spending.

The selection of the most appropriate procurement method is critical for both the client and other project participants as it is an important factor that contributes to the overall client's satisfaction and project success. This selection will be dependent upon a number of factors such as cost, time and quality which are widely considered as being the most fundamental criteria for

clients seeking to achieve their end product 'at the highest quality, at the lowest cost and in the shortest time' (Hackett et al. 2007). The existence of a wide variety of procurement methods available to project developers on the market today has led to several comparisons being made on how the different procurement methods have performed at the end of the construction phase.

The public procurement in public hospitals, Kenya included has evolved significantly over the last decade. According to Public Procurement Oversight Authority (PPOA, 2007) the public procurement has evolved from an unregulated system in the 1960s to treasury controlled system in 1970s, 1980s and 1990s. Public procurement and disposal act was later introduced in 2005 and further new standards were introduced by Procurement Regulations of 2006 (PPOA, 2006). Prior to the introduction of Public Procurement and disposal Act of 2006 the procurement system was inefficient and the government lost a lot of money. According to the World Bank (1997), the procurement system was not transparent and was characterized with skewed competition; staff presiding over the system lacked capacity and were easily compromised; there was also an urgent need for a professional oversight body to instill discipline. These recommendations gave rise to the reforms that have characterized the procurement system in Kenya over the last decades.

The public procurement reforms in Kenya culminated in promulgation of the Public Procurement and Disposal act 2005 and the subsidiary legislation entitled Public Procurement and Disposal Regulations 2006 to provide a legal framework for regulating public procurement. The legislative framework provides for oversight functions to be carried out by the public procurement oversight authority, the Public Procurement Oversight Advisory Board and for an appeals mechanism to the Public Procurement Administrative Review Board. State corporations must carry out their procurement and disposal activities in accordance with the public procurement and disposal Act, the regulations, standard tendering documents, manuals and any directions of the PPOA. To ensure compliance, state corporations must, among other functions, prepare and follow their procurement plans, have a procurement unit staffed with procurement professionals, have procurement and evaluation committees, ensure all procurement procedures are properly documented and records properly maintained.

There are 5 public hospitals in Vihiga County. Vihiga County is an administrative region in the former Western Province of Kenya. Each Sub County in Vihiga County has one public hospital. The public hospitals in Vihiga County are Vihiga County referral hospital, Sabatia sub county hospital, Hamisi sub county hospital, Luanda sub county hospital and Emuhaya sub county hospital. Vihiga County referral hospital is a public hospital located in Mbale town Vihiga County in Vihiga County. It is the largest health facility in Vihiga County. It offers a variety of services to its patients that include: antiretroviral therapy, curative in-patient services, family planning, HIV counseling and testing, immunization and outpatient services.

Emuhaya Sub County hospital is a public hospital located in Wekhome, Emuhaya Sub County in Vihiga County. It offers a variety of services to its patients that include: antiretroviral therapy, curative in-patient services, family planning, HIV counseling and testing, immunization and outpatient services.

Sabatia Sub County hospital is a public hospital located in Sabatia, Sabatia Sub County in Vihiga County. The services it offers include: antiretroviral therapy, family planning, HIV counseling and testing, outpatient services and immunization.

Hamisi Sub County hospital is a public hospital located in Gisambai, Hamisi Sub County, Vihiga County. The services it offers include: antiretroviral therapy, family planning, HIV counseling and testing, outpatient services and immunization. Luanda Sub County hospital is a public hospital located in Luanda town, Luanda Sub County in Vihiga County. The services it offers include: antiretroviral therapy, family planning, HIV counseling and testing, outpatient services and immunization.

Knight et al. (2007) mentions that it is astonishing that so little research has been carried out into public procurement across different nations (and even within nations) to improve procurement when it is such a vital, significant part of all nations' economies. The basic presumption in public procurement in all public institutions is that contracts of a specified type and value will be procured using an advertised, competitive procedure that is open, fair and transparent, ensuring equality of opportunity and treatment for all candidates and tenderers. There are only limited circumstances where a procedure without advertised competition is permitted. The public procurement entities are legally bound to ensure this is achieved through the Public Procurement and disposal Act of 2005.

In 2003, the GOK began implementing reforms to address inefficiency in the use of public resources and weak institutions of governance. The reforms included the development of anti corruption strategies to facilitate the fight against corruption and the enactment of the public Officer Ethics Act 2003, the Anti-Corruption and Economic Crime Act, the Financial Management Act 2004, and the Public Procurement and Disposal Act 2005. The aim was to make the procurement process in government institutions more transparent, ensure accountability and reduce wastage of public resources. Currently, there are weak oversights institutions, lack of transparency, poor linkages between procurement and expenditure, delays and inefficiencies, poor records management, bureaucracy, rampant corruption, and Political interests in government institutions. The Public Procurement Oversight Authority in 2007 admitted that, procurement entities are faced with challenges when it comes to applying the legal framework for regulating public procurement and complying with the new provisions and standards. This study aims at assessing the factors influencing the use of alternative methods of procurement in public hospitals in Vihiga County.

The general objective sought to assess the factors influencing the use of alternative methods of procurement in public hospitals in Vihiga County. Specific objectives aimed to determine the influence of public procurement policies on the use of alternative methods of procurement in public hospitals in Vihiga County, to find out how e-procurement affects the use of alternative methods of procurement in public hospitals in Vihiga County, to establish the effect of staff skills on the use of alternative methods of procurement in public hospitals in Vihiga County and to determine the effect of funding on the use of alternative methods of procurement in public hospitals in Vihiga County.

The study will benefit the hospital management teams of Vihiga, Emuhaya, Sabatia, Luanda, and Hamisi public hospitals by providing the findings on the factors that influence the use of alternative methods of procurement in public hospitals. This will help the public hospitals to adhere to the legal framework of regulating public procurement as stipulated in the Public Procurement and Disposal Act 2005.

The study will benefit other public hospitals in other counties in Kenya, policy makers and the government of Kenya in matters that regard to alternative procurement methods and the issues there in. In this case the government and other policy makers would be in a position to draw up or improve the current strategies guiding the uptake of procurement methods. The research will serve as a basis for further research in the field of procurement especially in the public hospitals.

II. LITERATURE REVIEW

2.1 Theoretical Framework

This will give a review of the research and help make logical sense of the relationships of the elements of the study.

2.1.1 Ethics Theory

Ethics is a branch of philosophy that seeks to define what is right and what is wrong. It helps us understand what actions are wrong and why they are wrong. Across the world, not all cultures share the same ethical commitments, and cultural relativism acknowledges that (Desjardin, 2008).

It is ideal that laws of a particular nation match their ethical commitment; even though some laws are changed to meet the ethical commitments, in most cases one may find that what is ethically right, sometime lacks legal backing. But in such cases, it is only strong personal ethical commitment that can help guide behavior. Even where there is strong personal ethical commitment, there are also cases of conflicting ethical positions (Desjardin, 2008). There are various philosophical approaches to environmental ethics, but only three will be discussed here; anthropocentrism, biocentrism and egocentrism. Anthropocentrism or human centered ethics is the view that all environmental responsibility is derived from human interests alone. It assumes that only human beings are morally significant and have direct moral standing. Since the environment is crucial to human well-being and survival, there is a duty towards the environment; a duty derived from human interest (Desjardin, 2008). Biocentrism is a life centered moral responsibility. According to the broadest version of biocentrism theory, all forms of life have an inherent right to exist (Desjardin, 2008). Egocentrism maintains that the environment deserves direct moral consideration and not consideration that is merely derived from human or animal interests. It suggests that the environment has a moral worth (Desjardin, 2008). According to Kaplan (2009), there are three main sources of rules that regulate behavior of individuals and businesses; the law, non – legal rules and regulations and ethics. If a business is breaking the law, by not complying with one of the many environmental laws requirements. The business would want to move from that point of counter compliance.

2.1.2 Sustainability Theory

Sustainability means meeting the needs of the current generations without compromising the ability of future

generations to meet theirs. It seeks to promote appropriate development in order to alleviate poverty while still preserving the ecological health of the landscape. Sustainability works to understand the connections between environment, economy and the society. In 2000, the World Bank published *The Quality of Growth*, advocating a broadening of the growth framework to a complementary agenda involves key quality aspects in the structural, human, social, and environmental dimensions of sustained growth, emphasizing a more equitable investment in people, and the need to sustain natural capital, dealing with global financial risks, improving governance and controlling corruption. The World Business Council for Sustainable Development Report, WBCSD, (2005), *Creating Business Value and Accountability*, restates the need to increase accountability and change the business approach to sustainable development. Accountability and value creation must be made mutually reinforcing throughout any enterprise, integrating sustainable development amongst all areas of business practice, rather than creating a 'specialist silo.' Although not specific policy responses, the two reports suggest a change in the policy outlook of international institutions (WBCSD, 2005). According to a research report from the Economist Intelligence Unit by ExxonMobil (2011), there is growing importance of corporate sustainability in enabling companies to compete and to attract customers. Business both impacts and relies on the availability and health of our natural resources. In recognizing this connection and protecting wildlife habitat and biodiversity in and around their operations the survey claims that the adoption of sustainable practices does not cause companies' share prices to rise. It could be that companies with a strong financial performance simply have more resources to devote to sustainability. What the findings do show, however, is that it is possible to take a proactive position on social and environmental issues while still delivering robust financial growth. Understanding the full life cycle of their operations is important to operating in an environmentally sustainable manner and involves four key steps: Assessing the surroundings; Designing the facilities and operations; Operating with integrity and Restoring the environment.

2.2 Conceptual Framework

The conceptual framework for this research brings into view the independent and dependent variables of the study. The independent variables are the variables that I will influence in order to decide on their effect on the dependent variable. They will help me foresee the amount of discrepancy that occurs in the dependent variable (Kothari, 2008). The value of the dependent variable depends on the independent variables. The independent variables will include: public procurement policies, e-procurement, staff skills and funding. The dependent variable is the use of alternative methods of procurement in public hospitals in Vihiga County. The relationship between independent variables and the dependent variable is of insightful significance as it will clearly lay down the factors influencing the use of alternative methods of procurement in public hospitals in Vihiga County

2.2.1 Public procurement policies

The Public Procurement Oversight Authority (PPOA) was established under an Act of Parliament, the Public Procurement and Disposal Act (PPDA) of 2005. Among other things the Act

established a semi-autonomous oversight body, the Public Procurement Oversight Authority (PPOA). The Authority is among other responsibilities charged with ensuring that all procurement entities observe the provisions of the procurement law. PPOA is mandated with the responsibility of: ensuring that procurement procedures established under the Act are compiled with; monitoring the procurement system and reporting on its overall functioning; initiating public procurement policy; and assisting in the implementation and operation of the public procurement system (PPDA, 2005).

PPOA being at the center of the procurement process in Kenya is well placed to drive the procurement sustainable agenda. Backed by a strong legislative framework, PPOA controls what public organizations can do or not do in their procurement process. It therefore acts as a strong intervening variable in the public hospitals' procurement processes by making sure that all the procurement activities are executed within the legal framework. PPOA is mandated to enhance national socio-economic development by facilitating and overseeing the implementation of an effective and efficient public procurement and disposal system. The Public Procurement and Disposal Act, 2005 is meant to help public organizations to: maximize economy and efficiency; promote competition and ensure that competitors are treated fairly; promote integrity and fairness of public procurement procedures and to facilitate the promotion of local industry and economic development.

Government policies and regulations are very rigid external factors which affect the procurement selection. Hence Hashim *et al.* (2006) argued that, client's choice of a procurement method could be affected by various government policies. This could be seen where the clients have to follow government procedures in choosing a particular procurement method. Dye (2000) states that public policy is whatever governments choose to do or not to do. Cochran (2009) & Malone (1995) carry this further, stating that public policy consists of political decisions for implementing programmes to achieve social goals. The increased scrutiny procurement is receiving warrants a mention, Coggburn (2003), where all public agencies, regardless of size, require the purchase of goods and services. Sound public procurement policies and practices are among the essential elements of good governance (KIPPRRA, 2006). Sound public procurement policy brings immediate tangible macroeconomic benefits where more cost-effective procurement relaxes the budgetary pressure and creates fiscal space (Vogel, 2009). Although many countries still have 'closed' procurement regimes, public procurement has become an international concern.

This is evident from the fact that the public sector represents about 50% of many of the world's economies in terms of spending on providing services and procuring from the private sector. Therefore, many countries have developed a highly evolved procurement regime, which recognizes the universal fundamentals of public procurement (World Bank, 2002). It is therefore evident that, if the procurement function fails to deliver quality goods and services in a timely fashion and at a value for money price, the performance of government suffers (Coggburn, 2003). All procurements regardless of their value or complexity follow a standard sequence of actions. This is known as the procurement cycle. The cycle involves a series of steps that must take place to supply a production line or to replenish stock in a

distribution center. The Public Procurement and Disposal Act, 2005 provided the basic procurement processes to be followed by all procuring entities. Although the procurement processes and rules may vary slightly for different methods of procurement, depending on whether the requirement is for supplies, works or services, all processes usually follow the same basic steps. The steps include: procurement planning where the procuring entity is required to produce an annual plan of all the procurements it intends to carry out in the next financial year; a procurement requisition is filled with clear specifications and terms of reference; confirmation of availability of funds is done; specifications are reviewed, the method of procurement, the evaluation criteria and the potential supply market; the procurement method is approved; preparation of tendering method is done; approval of tendering documents; advertisement and invitation for tenders; receipt and opening of tenders; evaluation of tenders; review of the evaluation report (approval or rejection); award of contract; communication of the award; review; signing of the contract; contract monitoring; and finally performance evaluation (PPDA, 2005).

The EU Public Procurement reforms of 2006 took into account changes in procurement practice, including greater use of electronic trading and ICT (Ian, 2009). The UK regulations were brought into operation in 2006. The purpose of the rules was to open up the public procurement market and to ensure the free movement of goods and services within the EU and in most cases they required competition. The EU rules reflect and reinforce the value for money focus of the government procurement. The Directive 2004/18/EC sets out the legal framework for public procurement. It applies when public authorities seek to acquire goods, services, or works. It sets out procedures that must be followed before awarding a contract when its value exceeds thresholds, unless it qualifies for an exemption (e.g. on grounds of secrecy). The government of Kenya through its parliament enacted an Act of parliament, the Public Procurement and Disposal Act, 2005 to establish procedures for efficient public procurement and for the disposal of unserviceable, obsolete or surplus stores, assets and equipment by public entities and to provide for other related matters. The purpose of this Act was to establish procedures for procurement and the disposal of unserviceable, obsolete or surplus stores and equipment by public entities to achieve the following objectives: To maximize economy and efficiency; To promote competition and ensure that competitors are treated fairly; To promote the integrity and fairness of those procedures; To increase transparency and accountability in those procedures; To increase public confidence in those procedures; To facilitate the promotion of local industry and economic development.

Public procurement practitioners have always walked on a tight rope. Their ability to accomplish procurement objectives and policies is influenced very much by internal forces including: Interactions between various elements of the public procurement systems, various officials and organizations in the three branches of government, and various actors and sub-agencies within a department or executive agency and actors and organizations external to sub-agencies; Types of goods, services and capital assets required for an agency's missions; Professionalism or quality of procurement workforce staffing levels (for example ratio of procurement practitioners to contract actions) and budget

resource. The general principles of government procurement have been taken for many years within the public sector (Ian, 2009). They can be summarized as follows: Purchasing should be based on value for money; Competition should be used to acquire goods and services (unless there is a convincing reason to the contrary); There should be clear definition of the roles and responsibilities of personnel involved in specifying a need, giving financial authority and making procurement commitments; There should be separation of the financial authority and purchasing authority; There should be separation of duties between personnel who receive goods and services and those who authorize payments; Requirements which are above a certain financial threshold are normally required to be advertised in accordance with EU regulations on public procurement.

2.2.2 E-procurement

According to Schapper (2003), E-procurement is the purchase of goods and services electronically. It is an integral part of an overall strategic procurement plan in the current business environment. The plan includes, but is not limited to strategic sourcing or supplier rationalization, supply chain automation and participation in one or more market places. The advent of the internet as a business systems platform has been a catalyst for major changes in the operation and status of organizational procurement.

One of the goals of procurement is to establish a competitive price, while e-procurement utilizes electronic commerce to identify potential sources of supply, to purchase goods and services, to exchange contractual information and to interact with suppliers. Applying e-procurement in the healthcare system remains unexplored. It lacks an efficient e-procurement mechanism that will enable hospitals and healthcare suppliers to electronically exchange contractual information, aided by the technologies of optimization and business rules. The development and deployment of e-procurement systems requires a major effort in the coordination of complex interorganizational business processes.

Early e-procurement forecast significant improvements in procurement costs, improved status of the purchasing function, and changes the structure of supply markets (Anne, 2008). According to FT (2012), e-procurement promotes collaboration between buyers and sellers. Many established and ICT compliant companies are setting up overlapping trading information exchanges. Consolidation is thus inevitable. Companies such as Samsung Corporation in South Korea, and Japan's Mitsubishi Corporation and Itochu are among those at the forefront of Asia's e-procurement activity. This is in recognition of the need to ensure that their trading business is not snatched away by new online competition. They have been streamlining their purchasing activities and setting up a variety of e-procurement market places (Williams, 2005).

The national e-procurement Research Project in Australia was initiated in 2003 in response to ongoing interest among the business and academic communities about the current status of e-procurement in Australian industries and organizations. The broad aim of the project was to assist organizations in Australia to plan for, implement and assess the impact of information system enabled innovations in procurement. A key element of the project was a series of national surveys of e-procurement adoption and implementation NeRPA (2003). The focus was in

the use of e-procurement to enable value creation and collaborative commerce. This broader business oriented view encompasses a wider span of activities ranging from strategic sourcing and supplier relationship management to through to settlement and payment of goods (Knudsen, 2002). The focus was on both the strategic and operational aspects of e-procurement.

Information technology has already penetrated to the health care organizations, promoting their efficiency and effectiveness. Electronic procurement, as an application of information technology, abolishes the traditional procurement procedures introducing information systems and the use of computers in purchasing.

2.2.3 Staff skills

Procurement is no longer considered a clerical function performed independently by untrained individuals within a governmental agency (National Institute of Governmental Purchasing, 2001). Qualified staff that is competent and skilled will help the organization to achieve its goals and objectives by being efficient and effective when carrying out their various functions. For an organization to succeed, qualification is therefore a pre-requisite and must be matched with job requirement, hence the need to hire and develop ambitious procurement personnel.

If staff involved in procurement procedures is not qualified and competent, then there will be ineffectiveness in the procurement services. Bailey and Farmer (2002) says that for the procurement function to achieve a superior performance, it's necessary to recruit, train and develop personnel with the capacity and motivation to do a better job. Carter and price (2003) indicate that training of staff is vital if full use is to be made of their abilities and talents. Coe (2009) says that it's important to ensure that sufficient number of the appropriate caliber is available to the organization in pursuit of its objectives. Incompetent employees can render procurement services virtually ineffective.

Lysons and Farrington (2012) identify the skills that are required for procurement officers as follows: Coordination: adjusting actions in relation to others' actions. Critical thinking: using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems. Speaking: talking to others to convey information effectively. Active listening: giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate and interrupting at inappropriate times. Management: managing one's own time and the time of others. Negotiation: bringing others together and trying to reconcile differences. Persuasion: persuading others to change their minds or behavior. Operations analysis: analyzing needs and product requirements to create a design. Quality control analysis: conducting tests and inspections of products, services, or processes to evaluate quality or performance. Management of material resources: obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work.

Lysons and Farrington (2012) further identify the knowledge needed to be a procurement officer as follows: administration and management, production and processing, law and government, mathematics, customer and personal service,

transportation, personnel and human resources, economics and accounting, computers and electronics, clerical, psychology, communication and media, education and training, sales, marketing and telecommunications.

Staff training and development activities are important in all businesses. In addition to improving the skills of the staff specific to the business process, it is important for the skills to be up-to-date (Victoria, 2014). When new staff members begin working in the business, they will need to be trained appropriately in order to fulfill their role. You may rely heavily on the existing staff members to achieve this. Existing staff members may need to up-skill to keep them challenged and engaged. The changing circumstances in the procurement processes require new learning for example those brought about by new technology (Victoria, 2014).

Finding and keeping workers with the knowledge and skills to get the job done is critical in today's workplace. A skilled workforce is often the key to an organization's growth and stability and it could be the determining factor in the success of your business.

2.2.4 Funding

With enough funds the hospitals can run their activities efficiently and effectively while with inadequate funds they may have difficulties in running their activities (Carter & Price, 2003). According to Dobler and Burt (2006), Funds can be a constraining factor to the selection of the procurement procedure to use when funds allocated cannot cater wholly for the organizations requirements within the budget period. According to Burton (1981), other factors that may affect allocated funds include the variability in user demand patterns and frequent price variations. The stature of financial management in the organization can affect adversely its effectiveness and in the finance resource application in various activities.

The 2005/2006 government financial settlement meant that many government institutions were forced to make substantial cuts in their services. Staffing levels have also been affected and many government institutions have had to make staffing cuts. Although this has meant that redundancies have been made, many authorities have chosen to leave positions vacant rather than choose this option. The loss of staff has resulted in the loss of specialist staffs with most institution employing clerks, and this has affected the individual procurement services.

A reasonable mix of Government and donor resources has been used to support the growth in the public hospitals procurement and supply chain activities. Securing funding of public hospitals' procurement activities through the mechanism of grants often results in service and delivery delays. These delays have a particularly notable impact on the procurement units in the public hospitals, since confirmation of funding often governs when procurement may be initiated, and the timing of such confirmation is generally unpredictable. The public hospitals' resources have not always been adequate to meet all their procurement requirements on a timely basis. Little improvements have been made in this area and it remains a major challenge in the public hospitals.

Health care funds in Kenya come from the public (government), private companies and donors. The Kenyan health sector relies heavily on out-of-pocket payments. The National Hospital Insurance Fund is the main type of health insurance in

Kenya. Health services in Kenya are purchased by different organizations through various mechanisms. The main purchaser is the MoH which operates 191 government hospitals, 465 health centres and 2122 dispensaries. Other purchasing organizations include the local government, NHIF, CBHIs, private health insurance companies and employers (Jane and Vincent, 2011).

The public sector facilities are allocated budgets and staffs are paid salaries using pooled tax funds. Some donors have allocated money to support the health sector in Kenya. There is no agency responsible for ensuring that public funds allocated to health providers are used appropriately (Jane and Vincent, 2011).

2.2.5 Alternative procurement methods

The adoption and use of alternative procurement methods is not new. Not all public procurement is carried out in order to meet the direct needs or goals of public authorities. There are also instances of procurement cases where purchasing by state or public sector actors is directed not only towards fulfilling their own (original) tasks, but also aims to influence and support certain patterns of demand on the part of private consumers. In addition, there are some instances in which the latter goal is primary. On this basis, we can distinguish three main varieties of public procurement: direct, co-operative, and catalytic procurement. Essentially, these distinctions refer to different types of end-users and corresponding categories of societal need. The theoretical foundation for these distinctions was established in an earlier dichotomy between "direct" and "catalytic" procurement (Edquist & Hommen, 2000, pp. 22-23). In direct public procurement, the public agency or authority that carries out the procurement is the primary end-user of the product in question, and the needs that motivate the procurement are thus intrinsic to this procurer.

In catalytic public procurement, the procurement is conducted on behalf of end-users other than the public agency or authority that carries out the procurement and the societal needs that motivate the procurement can thus be said to be extrinsic to the procurer and located primarily within the private sector, among firms or individual consumers. It is also possible to refer to a third, "mixed" type of case, where the public agency or authority that carries out the procurement is one, but not the only, intended end-user of the product in question, and the needs that motivate the procurement are thus shared by the procurer and other intended end-users.

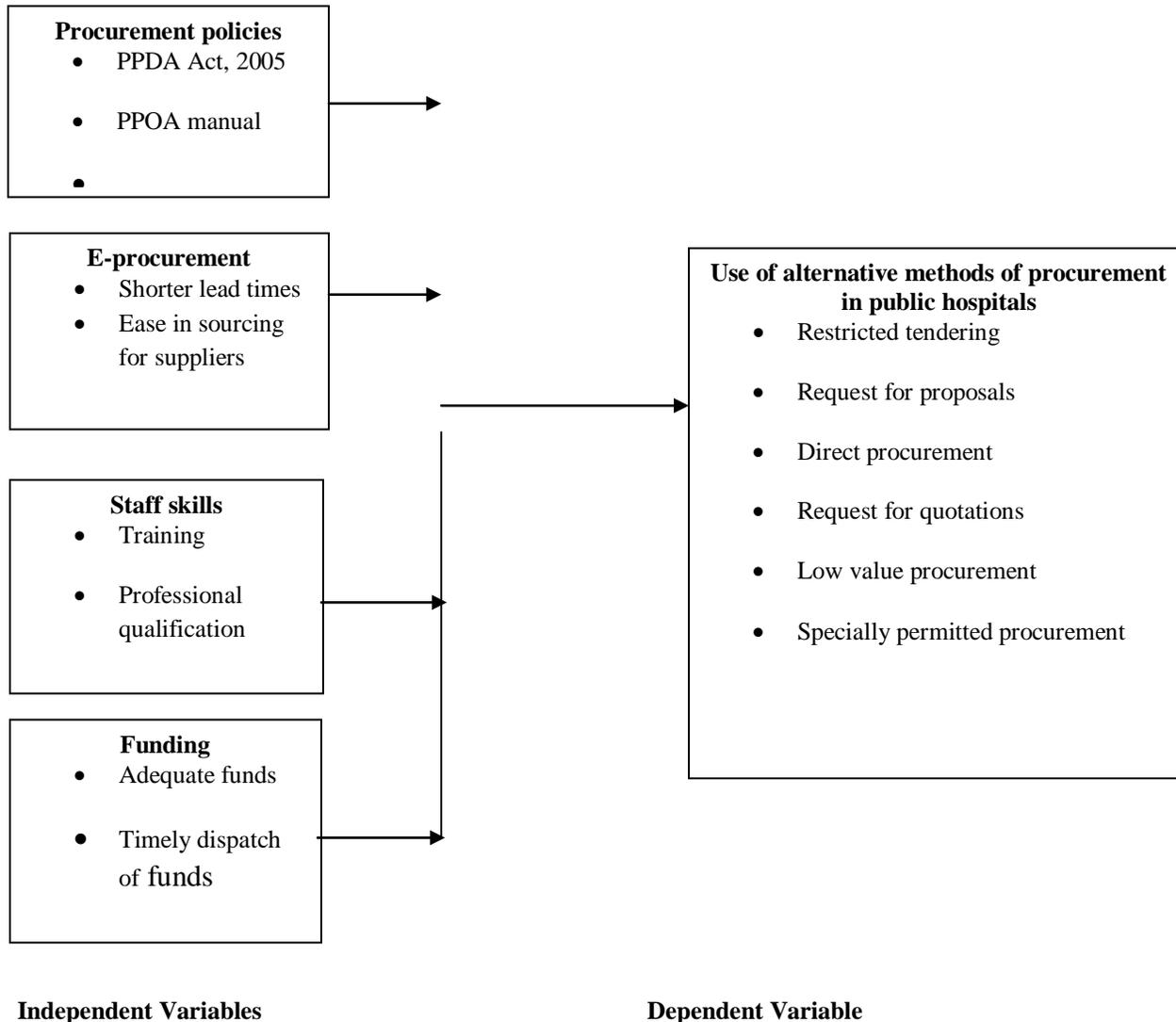


Fig 2.1 Conceptual Framework

2.3 Empirical Review

Open tendering is the main procurement procedure. There are seven different methods of procurement each with different conditions of use (PPDA, 2005). The alternative methods of procurement include the following:

Restricted tendering: A procuring entity may use restricted tendering if the following conditions are satisfied; competition for contract, because of the complex or specialized nature of goods, works or services is limited to prequalified contractors; the time and cost required to examine and evaluate a large number of tenders would be disproportionate to the value of the goods, works or services to be procured; there are only a few known suppliers of the goods, works or services as may be prescribed in the regulations.

Direct procurement: A procuring entity may use direct procurement as allowed under subsection (2), (3) or (3) as long as the purpose is not to avoid competition. A procuring entity may use direct procurement if the following are satisfied: there is

only one person who can supply the goods, works or services being procured; there is no reasonable alternative or substitute for the goods, works or services; there is an urgent need for the goods, works or services being procured and because of the urgency the other available methods are impractical; the circumstances that gave rise to the urgency were not foreseeable and were not the result of dilatory conduct on the part of the procuring entity; the following procedure in line with direct procurement shall apply; the procuring entity may negotiate with a person for the supply of goods, works or services being procured; the procuring entity shall not use direct procurement in a discriminatory manner; the resulting contract must be in writing and signed by both parties.

Request for proposals: A procuring entity may use a request for proposal for a procurement if the procurement is of services or a combination of goods and services; the services to be procured are advisory or otherwise of a predominately intellectual nature.

Request for quotations: A procuring entity may use a request for quotations for procurement if: the procurement is for goods that are readily available and for which there is an established market; the estimated value of the goods being procured is less than or equal to the prescribed maximum value for using requests for quotations

Procedure for low-value procurements: A procurement entity may use a low value procurement procedure if the estimated value of the goods, works or services being procured are less than or equal to the prescribed maximum value for that low-value procurement procedure; any other prescribed conditions for the use of the low-value procurement procedure are satisfied

Specially permitted procurement procedure: A procurement entity may use a procurement procedure specially permitted by the authority which may include concession and design competition.

According to Ian (2009), the time allowed for responses or tenders depends on which award procedure is used. He provided four award procedures that include: Open procedure, under which all those interested, may respond to the advertisement in the OJEU by tendering for the contract. Restricted procedure, under which a selection is made of those who respond to the advert and only they are invited to submit a tender for the contract. This allows purchasers to avoid having to deal with an overwhelming large number of tenders. Negotiated procedure under which a purchaser may select one or more persons with whom to negotiate the terms of the contract. Public authorities have a free choice between the open and restricted procedures, but may only use the negotiated procedure in the limited circumstances set out in the regulations. This tends to be where a contract is a very complex one. Competitive procedure where complex contracts are involved and it is not possible to objectively define the technical means of satisfying buyers needs or it is not possible to satisfy the legal make-up of the project.

In order to ensure public accountability, yet to gain optimum impact through the use of commercial best practice, there is need for professional training for those personnel responsible for all the procurement activities (Ian, 2009).

With the public procurement function being the one most prone to corruption (Thai, 2008) transparency and accountability ought to be key cornerstones of public procurement. This is particularly true in developing countries (Thai, 2008) where there is insufficient transparency and competition in the procurement process. Daniel Kaufman (2005) of the World Bank estimates that more than US\$1 trillion is paid annually in bribes (Thai, 2004). With 25% of Africa's GDP estimated to be lost every year to corruption (Thachuk, 2005 as cited by Estach & Limi, 2011), it is also clearly a major factor that influences procurement policy development. Garcia (2009) explains that public procurement raises many complex problems, beginning with unclear and opaque rules, which are the product of poor public policies, and the corruption and inefficiency caused by outdated practices. Garcia (2009) mentions that public procurement faces many challenges, some of them practical which threaten competition, transparency and equality of treatment, and some of them shadowy, such as dealing with cartels and the fight against corruption.

Accountability is government's obligation to demonstrate effectiveness in carrying out goals and producing the types of

services that the public wants and needs (Segal and Summers 2002). Lack of accountability creates opportunities for corruption. Brinkerhoff (2004) identifies three key components of accountability, including the measurement of goals and results, the justification or explanation of those results to internal or external monitors, and punishment or sanctions for non-performance or corrupt behaviour. Strategies to help increase accountability include information systems which measure how inputs are used to produce outputs; watchdog organizations, health boards or other civic organizations to demand explanation of results; performance incentives to reward good performance; and sanctions for poor performance. In South Africa, a district health planning and reporting system was used to improve management control and hold government agents accountable for their decisions. By combining financial and service data, the reporting system drew attention to clinics and programmes that had unusual indicators, and helped officials to explore root causes for performance differences, including possible corruption (Vian and Collins 2006). Information needed to fulfill their own task, thus minimizing chances for collusion and drug diversion (Vian 2006).

2.4 Critique of the existing literature

The literature reviewed according to Grierson and Needham (2006) argue that public procurement policies and appropriate use of the alternative methods of procurement reduces the likelihood of unethical behavior in the public sector, reassures the public and instills confidence in all stakeholders concerning the integrity of decisions as regards selecting a procurement method. This is not the case in Kenya, where demonstrated accountability does not always match the reduction of unethical behavior in procurement activities. The reviewed literature doesn't identify lack of appropriate use of procurement procedures and poor adherence to the public procurement policies as the cause of corruption in the public hospitals

2.5 Research Gaps.

There is need for a well functioning public procurement system where the alternative methods of procurement are used appropriately. This is particularly true for developing countries where procurement usually accounts for a high proportion of total expenditure. Kenya is committed to improving efficiency in the public procurement system at every opportunity for the purpose of enhancing accountability in decision making structures, adherence to the public procurement policies, professionalism to improve procurement performance; transparency in the procedures and policies that regard procurement. However, this can only be achieved with a full understanding of the factors influencing alternative methods of procurement. There is lack of sufficient information on these factors locally in Kenya to enable the government to fulfill its commitment. The existing literature in Kenya fails to capture the influence of those factors on the use of alternative methods of procurement. This study will therefore assess the factors influencing the use of alternative methods of procurement in public hospitals in Vihiga County.

2.6 Summary

S6und public procurement policies and practices are among the essential elements of good governance. Furthermore, a good procurement practice should embrace: efficiency, which requires that procurement processes be carried out as cost effectively as possible, where suppliers should be treated fairly, without discrimination or prejudice. Providing the public with goods, services and works is a complex process involving both the private and public sectors. The authors fail to bring the clear picture that corrupt procurement officers can also purchase sub-standard goods, services and works.

A sound procurement system is important in the operations of state corporations, adherence to public procurement policies, appropriate use of alternative methods of procurement, and the business environment are vital in the proper functioning of state corporations.

III. RESEARCH METHODOLOGY

The researcher utilized a descriptive survey research design as this allowed for an in- depth investigation of the problem under study (Yount, 2006). The design accurately described an association between variables minimizing bias and maximizing the reliability of the data (Kothari, 2004). Questionnaires were distributed to the respondents for collecting relevant data to the study. The research study targeted all the 118 procurement persons at the Vihiga County referral hospital, Emuhaya sub county hospital, Luanda sub county hospital, Hamisi sub county hospital and Sabatia sub county hospital. The study used a survey and a sample of 35 procurement personnel of the total population was obtained using simple random sampling method. The study used simple random sampling method in selecting the respondents to the study. In simple random sampling, a sample was selected so that each person in the population has the same chance of being included.

The sample frame of the study included a representative sample of the individuals working in the procurement functions at the hospitals. At least 30% of the total population is a representative (Borg & Gall, 2003). Thus, 30% of the accessible population was enough for the sample size in this study. Out of the 118 procurement personnel in the five public hospitals in Vihiga County, the researcher took 30% of the total population which was 35 respondents.

$$30/100 * 118 = 35.4$$

Therefore 7 respondents from each hospital were served with a questionnaire to respond to. The study relied on primary data. Structured questionnaires were developed and administered to the respondents who indicated their responses in the spaces provided. Structured questionnaires were used since they are

simple to administer and eased the data analysis process (Barnes, 2001)

A pilot study was conducted to pre-test the questionnaire as this brought to light the weaknesses of the data collecting instrument. The questionnaire was edited in the light of the results of the pilot study (Kothari, 2008). The researcher 1 presented four questionnaires, one procurement officer from the four public hospitals was selected randomly to check on any ambiguities in them. The feedback was of great help as their input was incorporated in the final drafting of the questionnaires. Reliability was tested using Cronbach’s alpha scores. ***Principal factor analysis was used to determine the content validity of the instrument***

Subsequent to the data collection, all the questionnaires were effectively checked for data authentication. The data was tabularized in line with the objectives of the study (Kombo & Tromp, 2006). The tabulated data was subjected to both quantitative and qualitative analysis. Quantitative data analysis was helpful in data evaluation because it provided quantifiable results that were easy to understand. Qualitative data analysis, on the other hand helped the researcher to gain in-depth understanding of the research findings. Quantitative data was analyzed through descriptive statistics in the form of frequencies tallies and percentages. The statistics were generated using statistical package for social sciences (SPSS) and data obtained was communicated through pie charts and tables. Qualitative data was analyzed by organizing them in accordance with the research questions and objectives.

After the analysis, the data was presented in tables and pie charts and recommendations and conclusions made thereafter.

IV. DATA PRESENTATION AND FINDINGS

This chapter presents the research findings through data analysis and presentation. This chapter begins with the demographic data of the research responses, age and the years of service at the public hospital. The research findings are in line with the research objectives and the research variables thus demonstrating the relationship between the various variables. The data is presented in form of tables and pie charts where necessary and they are in line with the research design and objectives.

4.1 Result of the pilot study

The study involved a random selection of 3 procurement personnel from 2 public hospitals in Vihiga County each. The findings are recorded below.

Table 4.1: Result of the pilot study

Variables	Cronbach’s
Public procurement policies	0.701
E-procurement	0.769
Staff skills	0.731
Funding	0.720

The findings of the pilot study showed that knowledge of the public procurement policies had a Cronbach’s reliability value of 0.71. The use of e-procurement had a reliability alpha value of 0.769. The staff skills in procurement had a reliability alpha value of 0.731 and the availability of funds had a reliability alpha value of 0.720.

4.2 Background Information

4.2.1 Response rate

Table 4.2: Response rate

Population	Frequency	Percentage	
35	31	89%	100%

From table 4.2, the response rate was 89%. Mugenda & Mugenda 1999, states that a response rate of 60% is good, and above 70% is perfect. Since the response rate is 89%, it is excellent.

4.3.2 Age of respondents

The study sought out the age of the respondents who were the procurement personnel in the public hospitals within Vihiga County. The findings were recorded in figure 4.1.

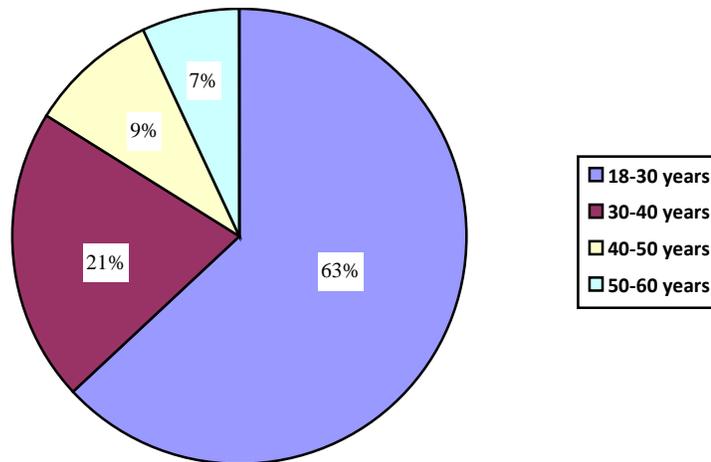


Figure 4.1: Age of the respondents

From the findings in figure 4.1, 63% of the respondents were aged between 18-30 years, 21% were aged between 30-40 years, 9% were aged between 40-50 years and 7% were aged between 50-60 years.

4.3.3 Years of service

The study sought to know the length of time the respondents have worked at their hospitals as this helped in determining their experience and knowledge of the hospital. The findings are indicated in figure 4.2.

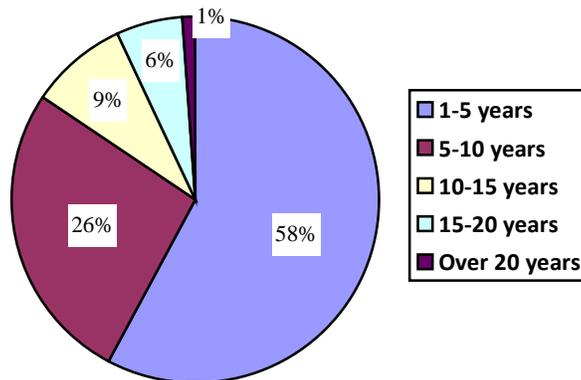


Figure 4.2: Years of service of the respondents at the public hospital

From the findings in figure 4.2, 58% of the respondents had worked at their hospitals for between 1-5 years, 26% had worked for between 5-10 years, 9% had worked for between 10-15 years, 6% had worked for between 15-20 years and 1% had worked for over 20 years.

4.3.4 Highest Level of Education

The study sought to know the highest level of education of the respondents. The findings are recorded in figure 4.3.

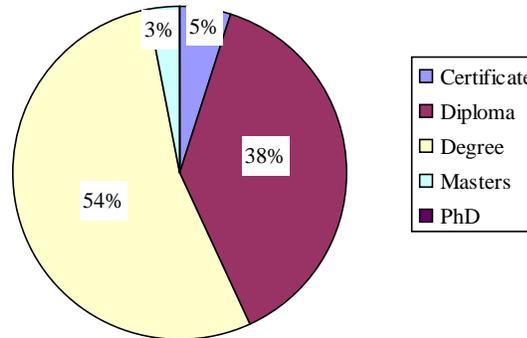


Figure 4.3: Highest level of education of the respondents

From the findings in figure 4.3, majority of the respondents, 54% were Degree holders, 38% were Diploma holders, 5% were Certificate holders, 3% were Masters degree holders and none of the respondents was a PhD holder.

4.4 Public procurement policies

The first objective of the study was to determine the influence of public procurement policies on the use of alternative methods of procurement in public hospitals in Vihiga County. The findings are recorded in the tables and chart.

Table 4.3: Public procurement policies

Question	Response		
Are you familiar with the requirements of the PPDA, 2005 and the PPOA manual for the health sector, 2009?	Yes (32%)	No (68%)	100%
Is the selection of a procurement procedure in your hospital greatly affected by the public procurement policies and regulations?	Yes (35%)	No (65%)	100%

From the finding in table 4.3, it was established that the majority of the respondents 68% were not familiar with the PPDA, 2005 and the requirements of the PPOA manual, 2009 of the health sector. 65% of the respondents believed that the procurement procedures at their hospitals are not affected by the public procurement policies in place and 35% of the respondents believed that some of the procurement activities at their hospitals are affected by the public procurement policies in place.

Table 4.4: Challenges faced in applying the procurement policies

Question	Response		
PPDA, 2005 is a new concept in the hospital procurement processes	Yes (86%)	No (14%)	100%
Split procurement at the hospital avoids the use of the proper procurement method	(65%)	(35%)	100%
Increased cost of open tendering method	(71%)	(29%)	100%
The procedure outlined in the PPDA, 2005 is cumbersome	(77%)	(23%)	100%
The documentation procedure is cumbersome	(83%)	(17%)	100%

From the findings in table 4.4, 86% of the respondents agreed that the PPDA, 2005 is a new concept in the procurement processes at the public hospitals while 14% of the respondents disagreed. 65% agreed that split procurement avoids the use of the proper procurement procedure while 35% disagreed. 71% agreed that open tendering is costly thus poses a challenge in using the method while 29% disagreed. The majority of the respondents 77% said that the procedure outlined in the PPDA, 2005 are cumbersome while 23% disagreed. 83% of the respondents said that the documentation procedure is cumbersome while 17% disagreed.

Table 4.5: Mostly used procurement method at the hospital

Statement	Response (%)		
Direct procurement	51%	100%	
Low value procurement	23%	100%	
Restricted tendering	11%		100%
Specially permitted procurement	6%	100%	
Open tendering	6%	100%	
Others	3%	100%	

From table 4.5, it was established that the mostly used procurement method in the public hospitals is direct procurement which had 51%, low value procurement had 23%, restricted tendering had 11%, specially permitted procurement had 6%, open tendering 6% and lastly other methods of procurement like request for quotations and requests for proposal had 3%.

4.5 E-procurement

The second objective of the study was to find out how e-procurement affects the use of alternative methods of procurement in public hospitals. The findings are recorded in the table and chart.

Table 4.6: E-procurement

Statement	Response	
Have you ever heard of e-procurement?	Yes (33%)	No (67%)
Does your hospital use e-procurement	Yes (01%)	No (99%)

From the findings in table 4.6, it was established that 67% of the respondents had never heard of e-procurement while 33% of the respondents had heard of e-procurement. It is clear that the public hospitals in Vihiga County do not use e-procurement in the selection of the procurement method to use. The findings are in support of Anne (2012) that e-procurement is not widely used in the public sector.

Table 4.7: sourcing for suppliers

Statement	Response (%)		
Internet	19%	100%	
References from other hospitals	16%	100%	
Books, journals and newspapers	6%		100%
Others	59%	100%	

From the findings in table 4.7, it was established that 6% source for suppliers using books, journals and newspapers, 16% source for suppliers using references from other hospitals, 19% source for suppliers via the internet and the majority 59% source for suppliers using other ways like the use of past records and the length of the relationship with their suppliers.

4.6 Staff skills

The third objective of the study was to establish the effect of staff skills on the use of alternative methods of procurement in public hospitals. The findings are recorded in the charts and table below.

Table 4.8 Academic qualifications in procurement

Statement	Response (%)		
Do you have the necessary academic qualifications in procurements	Yes (21%)	No (79%)	100%

From the findings in table 4.8 it was established that 79% of the respondents did not have the necessary academic qualifications in procurement while 21% of the respondents had the necessary academic qualifications in procurement.

Table 4.9: Training

Statement	Response	
Never been trained	53%	100%
Once a year	32%	100%
Twice a year	6%	100%
Once in every 3 months	9%	100%
Monthly	0%	100%

From the findings in table 4.9, It was established that 53% of the respondents had never been trained to improve on the procurement skills at their working stations, 32% had gone for training once a year, 9% had been trained once in every 3 months, 6% had been trained twice a year and non of the respondents had been trained on a monthly basis. This implies that the public hospitals in Vihiga County are not so keen in training their procurement officers to improve on their procurement skills.

Table 4.10: Staff skills

Statement	Response		
Is the selection of the procurement procedure in your hospital greatly affected by the procurement skills of the procurement officer?	Yes (64%)	No (36%)	100%
Have you ever been trained by the Public Procurement Oversight Authority?	Yes (01%)	No (99%)	100%

From the findings in table 4.10, 64% of the respondents agreed that the selection of the procurement method to use is greatly affected by the skills of the procurement officer while 36% disagreed. It was clear that the procurement officers at the public hospitals in Vihiga County had never been trained by the PPOA. The findings support the findings of Benon (2010) that the selection of a procurement method to use in the public sector is greatly affected by the skills of the procurement officer. Carr and Smeltzer (2000) assert that for purchasing to be at a strategic level, professionals need to possess a set of skills and competencies.

4.7 Funding

The fourth objective of the study was to determine the effect of funding on the use of the alternative methods of procurement in public hospitals in Vihiga County.

Table 4.11: Funding

Statement	Response		
Does the availability of funds affect the selection of the procurement method to use in your hospital?	Yes (87%)	No (13%)	100%
Do you have any other sources of funding apart from the government?	Yes (5%)	No (95%)	100%

From table 4.11, it was established that the availability of funds affect the selection of the procurement method to use because 87% of the respondents agreed to that while 13% disagreed. The public hospitals in Vihiga County heavily rely on the funds provided by the county government to carry out their procurement processes. The findings support the findings of Wayne and Habib (2010) that the availability of funds affects the management of the procurement function in the public sector.

4.8 Alternative methods of procurement

Table 4.12: Alternative methods of procurement

Statement	Response		
The requisition form filled by the user departments	Yes (86%)	No (14%)	100%
As a requirement of the PPDA, 2005	Yes (17%)	No (83%)	100%
The estimated value of goods, works or services to be procured	Yes (72%)	No (28%)	100%
The urgency of the requirement	Yes (92%)	No (8%)	100%
Limited number of suppliers	Yes (21%)	No (79%)	100%

From the findings in table 4.12, the majority of the respondents, 86% agreed that the requisition form filled by the user departments affects the selection of the procurement method to use at the public hospitals, 14% disagreed. 83% of the respondents said that the selection of the procurement method to use at their hospitals is not affected by the requirements of the PPDA, 2005, 17% disagreed. 72% agreed that the estimated value of goods, works or services to be procured affected the selection of the procurement method to use, 28% disagreed. 92% agreed that the urgency of the requirement affects the selection of the procurement method, 8% disagreed. 21% of the respondents agreed that the limited number of suppliers affected the selection of the procurement method to use, 79% disagreed.

Regression

Table 4.13 Model Summary for all the Variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.827 ^a	.685	.790	.387	1.850

Table 4.8 indicates that the value of the adjusted r squared R2 amount to 0.790 which is 79.0%. This shows that the factors that are not covered amount only to 20.8%. It therefore means that the four factors have a big influence on the use of alternative methods of procurement in public hospitals in Vihiga County.

Table 4.9: ANOVA for All Variables

Model	Sum of Squares	of Df	Mean Square	F	Sig.
Regression	1646.01131	4	.411	2.728	.000 ^b
Residual	75432.122	5	.151		
Total	77078.1333	9			

The ANOVA result for all variables indicates that there was a highly significant relationship between the variables at F = 2.728 and P = 0.000. This implies that there is a strong relationship between the four variables and the use of alternative methods of procurement in public hospitals in Vihiga County.

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Major findings

5.1.1 Influence of public procurement policies

The study found out that public procurement policies influence the use of the alternative methods of procurement in the public hospitals in Vihiga County as this provides a legal framework that the hospital procurement officers ought to adhere to.

5.1.2 Use of e-procurement

The study found that e-procurement is not widely used in the procurement activities of the public hospitals in Vihiga County. E-procurement can influence the use of an alternative method of procurement as it helps in sourcing for suppliers via the internet.

5.1.3 Effect of staff skills

The study found a high relationship between the staff skills and the procurement methods that are used at the public hospitals in Vihiga County. The use of the alternative method of procurement is greatly affected by the skill of the procurement officer undertaking the procurement processes at the public hospitals in Vihiga County.

5.1.4 Effect of funding

It was established that the availability of funds influenced the use of alternative methods of procurement in the public hospitals in Vihiga County. Delays in funds from the county

government encouraged the use of direct procurement because of stock-outs and the urgency of the requirement.

5.2 Conclusion of the Study.

The study found out that the public procurement policies influenced the use of alternative methods of procurement in the public hospitals in Vihiga County. E-procurement influences the use of alternative methods of procurement because suppliers can be sourced via the internet. The skills of the procurement staff in the public hospitals in Vihiga County influences the use of alternative methods of procurement. The availability of funds has a great effect on the use of alternative methods of procurement in the public hospitals in Vihiga County. Political interference is also another factor that most respondents mentioned as an influence in the procurement procedures at the county hospitals.

5.3 Recommendations for the study

The following are recommendations of the study based on the findings.

5.3.1 Influence of public procurement policies

The public hospitals should strictly adhere to the laid down procurement selection procedures in the PPDA, 2005. The hospital management should be on the fore front in ensuring that public procurement policies are adhered to by the procurement officers. The PPOA together with the hospital management should offer frequent training to the procurement officers in the public hospitals on the public procurement policies.

5.3.2 Use of e-procurement

The public hospitals in Vihiga County should incorporate the use of e-procurement. E-procurement helps in the selection of the alternative methods of procurement as it reduces procurement costs of sourcing for suppliers thus increased supplier accessibility.

5.3.3 Effect of staff skills

The public hospitals in Vihiga County should ensure that their procurement personnel have the necessary academic qualifications in procurement. This will help them apply professionalism in the use of alternative methods of procurement.

5.3.4 Effect of funding

The County government of Vihiga should be prompt in remitting the funds to the public hospitals. The availability of funds influences the use of alternative methods of procurement in the public hospitals. The reduction in lead time will greatly influence the use of alternative methods of procurement.

5.4 Areas for Further Study

From the recommendations, it is clear that public procurement policies, e-procurement, staff skills and funding influence the use of alternative methods of procurement in public hospitals in Vihiga County. I suggest the following areas for further study: public procurement skills requirements, public procurement policies, procurement method selection, e-procurement, and funding.

and policy relevance. *Health Policy and Planning* 19:371-9.

- [5] Brownell, J. (2005), *Strengthening the Purchase Supplier Partnership*. A working paper Cornell University.
- [6] Charles, L.C and Eloise, F.M. (1995). *Public Policy Perspectives and Choices*: McGraw-Hill.
- [7] Coggburn., J.D (2003), *International Handbook of Public Procurement*
- [8] Daniel, K. (2005), *Myth and Realities of Governance and Corruption*. World Bank.
- [9] Dess, Gregory G., G.T. Lumpkin and Marilyn L. Taylor. *Strategic Management*. 2ed. New York: McGraw-Hill Irwin, 2005.
- [10] Directive 2014/24/EU of the European Parliament and of the Council on Public Procurement and Repealing Directive 2004/18/EC (2014)
- [11] Dye, M.K. & Staphenurt, R. (1997) *Pillars of Integrity: The Importance of Supreme Audi Institutions in Curbing Corruption*. The Economic Development Institute of the World Bank.
- [12] Edquist, C., Hommen, L, and Tspouri, .L (2000). *Public Technology Procurement and Innovation*.
- [13] Garcia, F.J (2009). *E-procurement Management for Successful Electronic Government Systems*
- [14] Grierson, M., and Needham, R.(2006). *Ethics, Probity and Accountability in Procurement: Queensland Purchasing, Department of Public Works: Crime and Misconduct Commission: Commonwealth of Australia, Queensland,*
- [15] Government of Kenya, "The Public Procurement and Disposal Act 2005," Kenya Gazette Supplement No.3, 2005 of 29/12/2005, Nairobi, Government Printer.
- [16] Government of Kenya, "The Public Procurement and Disposal Regulations 2006," Kenya Gazette Supplement No.92, 2006 of 29/12/2006, Nairobi, Government Printer.
- [17] Griffin, (1988), "Organizing for collaborative procurement: an initial conceptual Framework", in Piga, P., Thai, K.V. (Ed), *Advancing Public Procurement*:
- [18] Hashim M., Yuet M.C., Hooi N.S., Heng S.M. and Yong T.L., 2006. *Factors influencing the Selection of procurement systems by clients*, International Conference on Construction Industry, 21st June-25th June 2006 Padang, Indonesia
- [19] Ian Longdin (2009). *Legal Aspects of Purchasing and Supply Chain Management*. 3rd Ed
Kasomo, D (2006), *Research Methods in Humanities and Education*.
- [20] Kenya Gazette Supplement No. 92 (2006). *The Public Procurement and Disposal Regulations*. Nairobi: Government of Kenya.
- [21] KIPPRA, (2006). *Public procurement policy in Kenya: The need for a coherent policy Framework*. Policy brief no. 3/2006
- [22] Knight, L., Harland, C., Telgen, J., Caldwell, N. (2007), "Public procurement: an introduction", In Knight, L., Harland, C., Telgen, J., Thai, K.V., Callendar, C., McHen, H. (Eds), *Public Procurement: International Case and Commentary*, Routledge, London,.
- [23] Kothari, C.R. (2008). *Research methodology: Methods and techniques*. New Delhi: New Age International Ltd Publishers
- [24] Otieno, (2004), *Procurement Activities in Public Institutions*.
- [25] Porter, M. (2008). *Competitive Strategy; Techniques for Analyzing Industries and Competitors*. New York: Free press.
- [26] Rameezdeen, R. and Ratnasabapathy, S. (2006) 'A multiple decisive factor model for Construction Annual Research Conference, the Royal Institution of Chartered Surveyors,
- [27] Reinikka and Svensson (2002), "The purchasing process in public procurement", in Knight, L., Harland, C., Telgen, J., Thai, K.V., Callendar, C., McHen, H. (Eds), *Public Procurement: International Case and Commentary*, Routledge, London,.
- [28] Segal and Summers 2002), *Improving transparency in pharmaceutical systems: strengthening Critical decision points against corruption*. Washington, DC: World Bank, Human Development Network, Latin American and Caribbean Region.
- [29] Soudry, O. (2007), "A principal-agent analysis of accountability in public procurement", in Piga, P., Thai, K.V. (Eds), *Advancing Public Procurement: Practices, Innovation and Knowledge-sharing*, Academics Press, Boca Raton, FL.
- [30] Thachuk, .K (2005). *Corrupt Public Procurement*.

REFERENCES

- [1] Adjei, A.B. (2003). *Sustainable Public Procurement, a new approach to good governance*.
- [2] Ajayi, O.M (2009), *Research Methods Community*.
- [3] Andrew, K. (2005). *Procurement Professional Magazine*.
- [4] Brinkerhoff D. W. (2004), *Accountability and health systems: Toward conceptual clarity*

- [31] Thai, K. (2008) Measuring Losses to Public Procurement Corruption: The Ugandan Case, 3rd International Public Procurement Conference Proceedings
- [32] Thai, K. (2009) International Handbook of Public Procurement. Boca Raton: Taylor and Francis
- [33] Thai, K. (2011). Towards New Horizons In public procurement. Florida: Academic Press
- [34] Thai, K. V. (2004) Introduction to Public Procurement, first edition. Florida Atlantic University.
- [35] Thai, K.V. (2005) Challenges in Public Procurement. In Khi. V. T, Araujo, A., Carter, Y. R., Callender, G., Drabkin, D., Grimm, R., Jensen, E.R.K., Lyd, E. R., McCue, P.C. &
- [36] Telgen, J.(Eds.)(2005) Challenges in Public Procurement: An international Perspective. Academics Press: Florida, USA.
- [37] Vian (2006), Paying for 'free' health care: the conundrum of informal payments in post-Communist Europe. In: Transparency International. In: Global Corruption Report 2006: Special focus on corruption and health London: Pluto Press. 62-71.
- [38] Vogel and Stephens, (1989), "procurement leadership: from means to ends", Journal of Public Procurement, Vol. 6 No.3, pp.274-95.
- [39] World Bank (2006) Methodology for Assessment of National Procurement Systems. World Bank.
- [40] World Bank report (2007), Key procurement functions typically and expertise requirement.
- [41] Yount, R.W. (2006). Research Design and Statistical analysis in Christian Ministry, (4th Ed)

AUTHORS

First Author – Laurine Muyuka Mukopi, Master of Science in Procurement and Logistics, Jomo Kenyatta University of Agriculture and Technology

Second Author – Dr. Amuhaya Mike Iravo, Supervisor, Jomo Kenyatta University of Agriculture and Technology

Teacher motivation and job satisfaction on intention to quit: An empirical study in public second cycle schools in Tamale metropolis, Ghana

Isaac Kosi*, Ibrahim Sulemana*, Janet Serwah Boateng**, Robert Mensah***

* School of Business, University of Cape Coast, Cape Coast

** Institute for Development Studies, University of Cape Coast, Cape Coast

*** Methodist University College, Accra

Abstract- The study investigated the influence of motivation and job satisfaction on teachers' intention to quit teaching in public senior high schools in Tamale Metropolis, Ghana. Data were collected using self-reported questionnaire from 203 teachers in selected schools in Tamale Metropolis. Cross-sectional survey design was used with questionnaire as the main data collection instrument using a multi-stage sampling procedure. Regression analysis and descriptive statistical analysis were employed in discussion of the data. The results revealed that job satisfaction made the most significant but negative contribution to intention to quit. Motivation made the least but significant contribution to intention to quit. It is recommended that training and development programmes as well as offering of more extrinsic motivation variables by all stakeholders in the education sector is required to retain more teachers in public schools.

Index Terms- Teaches, motivation, job satisfaction, intention to quit, turnover

I. INTRODUCTION

Employee turnover has come to gain greater attention of most governments and organisations all over the world because they have faced this problem at some stage of their development (Zahra, Irum, Saad & Chishti, 2013). Intention to quit has been acknowledged to be the best predictor of actual turnover (Micheal & Spector, 1982; Mobley, 1977; Horn & Griffith, 1995). Increasing body of research on employee turnover behaviour indicates that, tenure, job satisfaction, age, and organisation commitment are consistently related to turnover intentions and the actual turnover (Jonathan, Thibeli, & Darroux, 2013; Samad, 2006; Mbah & Ikemefuna, 2012). Intention to quit is defined as conscious wilfulness of employees to seek for other alternatives in other organisations (Tett & Meyer, 1993), Jacobs and Roodt (2007) cited in Hussain and Asif, (2012) contended that intention to quit are the mental decisions prevailing between an individual's approach with reference to a job to continue or leave the job. Intention of employee to quit is an indication of the level of job dissatisfaction of the employees in the organisation which is influence by motivation (Mbah & Ikemefuna, 2012).

In Ghana, as in many other African countries, quitting of jobs among teachers is a pervasive phenomenon. The Ghana National Association of Teachers and Teacher and Educational Workers Union (2009), for instance lamented that about 10,000

teachers leave the Ghana Education Service (GES) annually for various reasons. In addition, Mrs. Irene Duncan-Adanusa, the General Secretary of Ghana National Association of Teachers disclosed that an estimated 33,185 teachers in Ghana had abandoned their post in recent years to seek greener pastures (graphic.com.gh, 15th August, 2013). Among these reasons are motivation, job satisfaction and organisational commitment. Mueller, Boyer, Price and Iverson (1994) and Martin (2011) are of the view that job motivation and satisfaction are the most influential factors of intention to quit. The Northern Region of Ghana is one characterised with high rates of teacher turnover rate (GES, 2012), particularly Tamale Metropolitan Assembly but researches appear to be concentrated in the southern part with few dedicated to the northern sub-region. Moreover, though, the identified studies are efforts to resolve the problem of teacher retention, the simultaneous relationship among motivation, job satisfaction, organisational commitment and intention to quit have seldom been researched. Meanwhile an understanding of the linkages among the variables is critical to ensuring teachers retention. This is especially the case that various governments are striving to implement strategies to retain teachers (Mohan, 2010). This study therefore seeks to examine the influence of motivation and job satisfaction on intention to quit teaching among teachers in public senior high schools in the Tamale Metropolis.

Specifically, the study sought to:

- i. Determine what motivates teachers to go into teaching in senior high schools;
- ii. Examine the teachers' job satisfaction level;
- iii. Examine relationship between motivation and teachers' intention to quit;
- iv. Assess the relationship between job satisfaction and teachers' intention to quit;

The study has important implications for government policy and the lessons that flow from this study could shape Ghana government's teacher retention policies which may call for the putting up of much needed motivational packages to satisfy and retain teachers in public schools. The study may guide policy makers in Ghana Education Service and Ministry of Education in the formulation and implementation of pragmatic policies to motivate teachers to continue to stay in public second cycle institutions.

II. LITERATURE REVIEW

It is important to look at the influence of motivation and job satisfaction when discussing issues of employee turnover and retention, because motivation is one of the factors with greatest influence. Pinder and Latham (2005) defined motivation as a set of energetic forces that originate both within as well as beyond an individual's being, to initiate work-related behaviour and to determine its form, direction, intensity, and duration. The main central themes to the research such the concept of motivation, job satisfaction, turnover and all related literature are hereby by discussed.

Theoretical review

The main theoretical underpinnings for the study include Herzberg's two factor theory and The Effort-Reward Imbalance (ERI) Model (Siegrist, 1996; 1998). Frederick Herzberg introduced the two factor theory also known as the motivation and hygiene factors theory in 1959. According to the theory, certain characteristics tend to be consistently related to job satisfaction and others to job dissatisfaction. The factors which are called motivators provide the employee with satisfaction and they include the work itself, achievement, advancement, responsibility, and growth. The other factors which are non-job-related factors that cause dissatisfying experience for employees includes company's policies, salary, co-worker relation, and style of supervision. These factors are called Hygiene factors (Steers & Black, 1994). According to Herzberg (1959), the factor leading to job dissatisfaction are separate and distinct from those that lead to job satisfaction. Therefore, managers who seek to eliminate factors that can create job dissatisfaction may bring about peace but not necessarily motivate. They will be placating their workforce rather than motivating them. Therefore to motivate employees, they should offered opportunities for promotion, recognition, responsibilities, personal growth and achievement (Robbins & Judge, 2007).

The Effort-Reward Imbalance (ERI) Model (Siegrist, 1996; 1998) puts its emphasis on the reward rather than the control structure of work as well as emphasizing personal characteristics. Rewards are distributed to employees/employers by three transmitter systems: money (i.e. adequate salary), esteem (e.g. respect and support) and security/career opportunities (e.g. promotion prospects, job security and status consistency). The ERI Model claims that lack of reciprocity between 'costs' and 'gains' (i.e. high effort/low reward conditions) may cause a state of emotional distress which can lead to cardiovascular risks and other strain reactions like poor subjective health and sickness absence. If teachers are not adequately rewarded for their efforts, then it can be concluded by this model that, they will quit their jobs.

Turnover

Employee turnover is defined as the extent to which employees enter and leave a company in a given fiscal year (Society for Human Resource Management, 2012). It is measured as the ratio of the number of workers that had to be replaced in a given time period to the average number of workers (Agnes, 1999). On the other hand, Tett and Meyer (1993) regard turnover intentions as conscious wilfulness to seek for other alternatives in other organisation. Reviews on the antecedents of turnover intentions have highlighted intent to leave rather than

actual turnover as the outcome variable. Turnover of employee can have both positive and negative impact on organisation. Though new employees bring new ideas and vigor, employees voluntarily leaving organizations may have psychological and economic cost to the remaining employees and the organization respectively. The economic cost includes the cost incurred from recruitment processes to placement of newly hired employees. It also affects the brand name and image of the organization.

Motivational variables

The study will therefore look at both intrinsic and extrinsic motivational variables and how they influence teachers' job satisfaction and organisational commitment. Samuel and Chipunza (2009) found that training and development have significant influence on retention on both public and private organisations. Currall, Towler, Judge and Kohn (2005) found that pay satisfaction is significantly related with the intention to quit of public school teachers. Pay satisfaction has also been found to be associated with increased job satisfaction and greater intention to stay (Lum, Kervin, Clark & Sirola, 1998). Samuel and Chipunza (2009) noted that recognition and rewards for good performance are significant determinants of employees' retention, in both private and public sector organisations.

Motivation and Intention to Quit

Motivation drives employees to develop psychological value for organization which is exhibited through their organizational citizenship behavioural tendencies. Thus helps to encourage productive behaviour and discouraging unproductive behaviour (Sahasini & Babu, 2014). Studies show that training and development have significant influence on retention on both public and private organisations (Samuel & Chipunza, 2009; Kaiser, 2006; Tremblay, 2000). Currall, Towler, Judge and Kohn (2005) found that pay satisfaction is significantly related with the intention to quit of public school teachers. Pay satisfaction has also been found to be associated with increased job satisfaction and greater intention to stay (Lum, Kervin, Clark & Sirola, 1998, Abeysekera, 2007). Job security has also been established to significantly influence employee retention (Samuel & Chipunza, 2009). In 2013, Asif, Hassan and Ramzan investigated the impact of motivation on employee turnover. The study shows that the importance of motivation of employee turnover in banking sector of Pakistan. Data collected from different banks and through regression and correlation result shows that the independent variable motivation is significant affect of employee turnover in banking sector which suggest that must increase motivation it would reduce the value of employee turnover in banking sector. From the following studies, the first hypothesis of the study is that:

H1: *There is a significant negative relationship between job satisfaction and intention to quit.*

Job satisfaction

Smith, Kendal and Hulin (1969) considered job satisfaction as the feelings a worker has about his or her job. Job satisfaction has also been considered as the fulfilment or gratification that one has about his job (Hopkins, 1983). As a measure of employees' feelings or state-of-mind regarding the nature of their work or work environment, job satisfaction can be group into;

affective and cognitive job satisfaction. Affective job satisfaction is the extent of pleasurable emotional feelings employees have about various aspects of their job situation as well as jobs overall. Cognitive job satisfaction on the other hand is the extent of employees' satisfaction, feelings and responses, with particular aspects of their jobs, such as pay, pension arrangements, working hours, and numerous other aspects of their jobs (Thompson & Phua, 2012). The feelings are associated with the individual's perception of the differences between what is expected as a fair and reasonable return and what is actually experienced. As such, cognitive job satisfaction can be unidimensional if it comprises evaluation of just one aspect of a job, such as pay or maternity leave, or multidimensional if two or more facets of a job are simultaneously evaluated.

According to Moorman et al. (1993) there are three practical points of view that illustrate the meaning of job satisfaction: First, is a valuable product of the society; second, is an early warning indicator at early stage for an organisation and third, can serve as a predictor of organisational behaviour. Similar to Moorman's point of view, Cranny et al (1992) found that job dissatisfaction could result in psychological frustration and low productivity. Job satisfaction plays a very critical role in attracting and retaining of employees' ability in an organisation (Brookfield, 1998). According to Brookfield, individuals with high levels of job satisfaction would have healthier physical and psychological records that very likely result in higher productivity and effectiveness in their job performance and will staying longer in organisation.

Job Satisfaction and Intention to Quit

Smith, Kendal and Hulin (1969) considered job satisfaction as the feelings a worker has about his or her job. Job satisfaction has also been considered as the fulfilment or gratification that one has about his job (Hopkins, 1983). As a measure of employees' feelings or state-of-mind regarding the nature of their work or work environment, job satisfaction can be group into; affective and cognitive job satisfaction. Affective job satisfaction is the extent of pleasurable emotional feelings employees have about various aspects of their job situation as well as jobs overall. Cognitive job satisfaction on the other hand is the extent of employees' satisfaction, feelings and responses, with particular aspects of their jobs, such as pay, pension arrangements, working hours, and numerous other aspects of their jobs (Thompson & Phua, 2012). According to Brookfield (1986), individuals with high levels of job satisfaction would have healthier physical and psychological records that very likely result in higher productivity and effectiveness in their job performance and will stay longer in organisation.

Similar to Moorman's point of view, Cranny et al (1992) found that job dissatisfaction could result in psychological frustration and low productivity. Job satisfaction plays a very critical role in attracting and retaining of employees' ability in an organisation (Brookfield, 1998). In addition, research has generally shown that job satisfaction is negatively related to turnover (Griffeth et al, 2000; Khatri et al, 2001; Tett & Meyer, 1993; Vong, 2003). The second hypothesis of this study is:

H2: *There is a significant negative relationship between job satisfaction and intention to quit.*

III. METHODOLOGY

The study was conducted in the Northern Region of Ghana, largest of the regions and it occupies a land mass of about 70,383 square kilometers (Ghana statistical service (GSS, 2010). The region is divided into 26 administrative districts. In this study, cross-sectional survey design was used. The study adopted cross-sectional survey design because it helped the researcher to obtain snap shot information concerning the status of the phenomena under investigation. Self-administered questionnaires were used to collect primary data. Selltiz, Jahoda, Deutsch and Cook (1976) opined that questionnaire survey is less expensive than other data collection instruments; produce quick results; can be completed at the respondent's convenience and offer greater assurance of anonymity.

Population and sample

The target population for the study was teachers in public second cycle schools in the Tamale Metropolis of the Northern Region of Ghana because it is regarded as the place with the highest rate of teacher turnover rate (GES, 2013). Out of the target population of 535 teachers in the selected public senior high schools in the Tamale metropolis, a representative sample of 217 was selected for the study using Krejcie and Morgan (1970) sample size determination formula and the return rate was 95.3% representing 203 participants. A multi-stage sampling procedure was used for the selection of the subjects for the study. The first stage involved the use of simple random techniques to select 7 senior high schools in Tamale metropolis out of 12 schools. The second stage consisted of the proportionate allocation of the 217 sample size to the selected senior high schools. In the third stage, the random sampling technique was used to select the required stratified sample size for each senior high school. These methods generated a total of 217 respondents

Data Analysis

Data from the structured self-administered questionnaire were properly cleaned and coded into the Statistical Product for Service Solution (SPSS), version 21. The descriptive statistics such as means, standard deviations, frequencies and percentages were used to describe the characteristics of the variables. Multiple regression analysis was subsequently conducted to identify the relationship among job satisfaction and motivation and teacher's intent to quit. The product-moment correlation coefficient (r) was used for this analysis. This correlation coefficient ranged from -1 to 1. The closer, the coefficient is to either of the limits, the stronger the relationship between the two variables (Howell, 2007). A correlation of .10 is described as a small effect size, a correlation of .30 is described as a medium effect size, and a correlation of .50 is described as a large effect size (Cohen, 1988). Finally, to explain teacher's intent to quit in terms of motivation and job satisfaction, multiple regression analysis was conducted to show how the dependable variables can be predicted by the independent variables.

$$IQ = A + \beta_1 M + \beta_2 JS + \ell$$

Where: A is the constant, β_1 and β_2 are coefficients. M- motivation; JS- job satisfaction; IQ- intention to quit and ℓ - error margin. The regression model was evaluated by the coefficient of determination denoted by R- square (R^2). This represents the proportion of variance in either variable which is linearly

accounted for by the other (Cohen, 1988). An R^2 of .01 represents a small effect size, and an R^2 of .09 represents a medium effect size and an R^2 of .25 represents a large effect size (Cohen, 1988). The classification was applied in the interpreting the coefficient of determination (R^2) in this study.

IV. RESULTS

Respondents' background characteristics

This section basically gives background information about respondents. It deals with the gender, age, educational level, category of staff, and teaching experience of the respondents.

The results revealed that majority of the teachers were males representing 139 (68.5%) and 64 (31.5%) were females. Majority 79 (38.9%) of the respondent fell between the ages of 30-39 years with only 55 (27.1%) being between the ages of 20-29 years. However, 69 (34.0%) of the respondents were between the ages of 40 years and above. The results suggest that, most of the teachers in the senior high schools in the Tamale Metropolis were in their youthful ages. Furthermore, it was realized that 173 (85.2%) of the respondents were professional teachers whilst 30 (14.8%) of the respondents were non-professional. This shows that majority of the teachers in the selected senior high schools in Tamale Metropolis in the Northern Region possessed the qualifications required for effective teaching in the senior high school. Also, it was discovered that majority 75 (36.9%) of the respondents had 10-19 years of experience in teaching, while 67 (33.0%) had < 5 years of teaching experience. Similarly, it was recorded that 37 (18.2%) of the respondents had between 20-29 years of teaching experience and the rest had >30 years of teaching experience. Since most of them have been teaching for over 5 years, it is long enough to conclude that they had gained much experience in teaching and would not want to quit.

Table 1: Teacher motivation factor(s)

Motivation	Mean	Std D
Opportunities for training and development given to staff is what motivated me to enter into teaching	3.03	1.29
Salary and benefits package given to teachers in GES motivated me to go into teaching	2.90	1.30
The recognition and rewards for good performance given to teachers motivated me to enter into teaching	2.91	1.29
The job security for employees in GES motivated me to enter into teaching	3.38	1.26

Source: Field work, 2014.

Table 1 presents results on the mean responses of respondents on what motivates them to go into the teaching job. The respondents show high agreement for the statements “the job security for employees in GES motivated me to go into teaching” and opportunity for training and development given to staff of GES motivated me to go into teaching” revealing a mean score ($\bar{X} = 3.38$) and ($\bar{X} = 3.03$) respectively. Contrarily, the mean score of respondents on the following statement “the recognition and rewards for good performance given to teachers motivated

me to enter into teaching” ($\bar{X} = 2.91$) and “salary and benefits packages given to teachers in GES motivated me to go into teaching” ($\bar{X} = 2.90$) indicates disagreement. The results therefore suggest that most teachers were motivated to go into teaching because of job security and opportunity for training and development and this finding is in line with Osipow (1983), Samuel and Chipunza (2009) as well as Smith and Cronje (2002) These earlier studies showed that people go into teaching for many reasons such as a life-long career, job security and steady income, in order to earn a living, love for the teaching profession, social mobility, progress on the job, prestige, salary and conditions of service and self-concept, and training and development. But Osipow (1983) noted that one makes a choice based on the fact that he wants to maximise profit. This may not necessarily be financial but something of value to the person. Osipow (ibid) asserted further that factors beyond human control influence people’s vocational choice. It was therefore concluded that factors other than what an individual demands such as government policy can influence ones career choice. Chance factors such as opportunity of getting appreciable salary and the community or locality one resides in can also influence an individual vocational choice.

Table 2: Level of job satisfaction among teachers

Satisfaction	Mean	Standard deviation
Teaching is an interesting job to me.	3.01	1.37
I am satisfied with my professional ability for doing my job.	3.06	1.39
I am satisfied with the cooperation I receive from school management team.	2.80	1.32
I am satisfied with autonomy I have in making decisions about my daily tasks.	2.87	1.35
The monthly salary is sufficient to meet all important expenses.	2.37	1.34
I am happy with the cooperation I receive from my workmates.	2.96	1.38
I feel comfortable with my present level of responsibility in my job.	2.83	1.33
I enjoy much freedom in my place of work.	2.76	1.31
I feel satisfied with the recognition I have in the community	2.63	1.28
I feel comfortable with my future incomes.	2.43	1.35
I am satisfied with in-service training opportunities available for me as a teacher.	2.45	1.30
I feel comfortable with rewards I get for doing a good job in the school.	2.46	1.27
I am comfortable with the promotion opportunities available to me as a teacher.	2.55	1.36
I enjoy collegial relationship with fellow teachers.	2.98	1.36

I feel protected against arbitrary dismissal from my current employment.	2.96	1.30
I feel fairly paid by my employer.	2.63	1.27
I feel satisfied with opportunities for training and professional development available.	2.67	1.33
I am not intending to change my profession.	2.67	1.28
The promotion process and procedure used by my employer are fair	2.55	1.32
Teaching is a challenging job to me.	2.92	1.32

Source: Fieldwork, 2014.

With respect to teachers' level of job satisfaction, the findings as shown in Table 2, indicated that teachers were dissatisfied with the promotion process and procedure used by their employers ($\bar{X} = 2.55$). The results also revealed that teachers were dissatisfied with their future income ($\bar{X} = 2.43$). However, the teachers were moderately satisfied with teaching as being an interesting job and their professional ability as teachers ($\bar{X} = 3.03$ and $\bar{X} = 3.06$).

From the results, it can be deduced that most of the teachers were not satisfied with their job. Thus, the findings of the study clearly indicated that teachers' job satisfaction was not at a high level to keep them in the profession; this could lead to the intention of the teachers to quit. This confirms what has been said in the literature by Thompson and Phua (2012) that, job satisfaction can be group into; affective and cognitive job satisfaction. Affective job satisfaction is the extent of pleasurable emotional feelings employees have about various aspects of their job situation as well as jobs overall. Cognitive job satisfaction on the other hand is the extent of employees' satisfaction, feelings and responses, with particular aspects of their jobs, such as pay, pension arrangements, working hours, and numerous other aspects of their jobs (Thompson & Phua, 2012). The feelings are associated with the individual's perception of the differences between what is expected as a fair and reasonable return and what is actually experienced.

These findings are also in consistent with the findings of Organ and Bateman (1991), Greenberg and Baron (1993), Moorman (1993), Brookfield (1998) and Demir (2002). Their findings are related to job satisfaction as observed in the responses. In an organisation where worker's needs are met in terms of recognition, salary, conditions of service, involvement in decision-making and good interpersonal relationships, workers would be satisfied and for that matter have positive feelings or attitudes toward their job. When this happens, worker's satisfaction would influence their performance thereby increasing their productivity level. The reverse would be the case if their needs were not met. To this end, for workers to be satisfied, motivation becomes a paramount importance to the issue of job satisfaction. It is for this reason that Brookfield (1998) noted that job satisfaction plays a very critical role in attracting and retaining of employees' ability in an organisation.

The results imply that most of the teachers in the second cycle institutions in the Tamale Metropolis had good intentions

for entering into teaching profession. This finding agreed with the findings of Osipow (1983), Smith and Cronje (2002), and Samuel and Chipunza (2009). These researchers showed that people go into teaching for many reasons such as a life-long career, job security and steady income, in order to earn a living, love for the teaching profession, social mobility, progress on the job, prestige, salary and conditions of service and self-concept, and training and development.

Osipow (1983) noted that one makes a choice based on the fact that he wants to maximise profit. This may not necessarily be financial but something of value to the person. Osipow (1983) notes further that factors beyond human control influence people's vocational choice. According to him, people have far less freedom in choice making and that what the individual does is what society expects of him. He also notes that chance factors influence man's decision making and that the organisation of society influences people's vocational choice. Added to this factor are economic opportunities. Osipow (1983) therefore claims that factors other than what an individual demands such as government policy can influence ones career choice. Chance factors such as opportunity of getting appreciable salary and the community or locality one resides in can also influence an individual vocational choice.

Similarly, Samuel and Chipunza (2009) study in South Africa on employee retention and turnover result showed that employees in both public and private sector organisations were, to a very large extent, influenced to stay in their respective organisations by a combination of intrinsic and extrinsic motivational factors. Hence, teachers' intention to enter into teaching to some larger extent depends on motivation. The study further sought to find out the intention of teachers to quit the teaching profession. Respondents were asked to indicate their intention to quit. The responses are presented in the table below.

Table 3: Teacher's intention to quit

Intention to quit	Mean	Standard deviation
I think a lot about leaving the organisation (G.E.S).	3.60	1.67
I am actively searching for alternative to the organization (G.E.S).	3.58	1.66
As soon as it is possible, I will leave the organisation (G.E.S).	3.60	1.68
Overall Mean = 3.593		

Source: Field Work, 2014.

The results from Table 3 revealed that, the majority of the teachers in the second cycle institutions in Tamale metropolis had high intention to quit the teaching job ($\bar{X} = 3.593$). Given the theory of planned behaviour reinforces a high likelihood of

intention being converted into actual behaviour, it is sufficient to infer that should an alternative presents itself, the teachers will quit teaching. They put this intention into actual behaviour by stating that next year should there be alternative, they will quit. This is due to weak retention mechanisms put in place to keep teachers on their jobs. This implies that the teachers in the second cycle institutions in the Tamale Metropolis selected for the study had intention to quit the job. This could be attributed to the fact that the teachers are not satisfied with the job. The results are in line with that of Mowday, Koberg, and McArthur (1984), Tett

and Meyer (1993), and Mohamed, Taylor, and Hassan (2006). In their views, intention to quit and turnover is linked to employee job satisfaction. Job satisfaction and turnover move in opposite directions; when job satisfaction is reported to be high, turnover is often low, and vice versa. This finding was also found to be in line with that of Jonathan, Thibeli and Darroux (2013) who found in their study that teachers in secondary schools in Tanzania had higher intention to quit teaching job.

Table 5: Correlation matrix among motivation and job satisfaction and intention to quit

	Motivation	Satisfaction	Intention to quit
Motivation	1		
Satisfaction	.467**	1	
Intention to quit	-.470**	-.792**	1

Source: Fieldwork, 2014

** Correlation was significant at ($p < 0.000$) (1- tailed)

Pearson product- moment correlation coefficient was employed to determine the relationships that exist among the study variables and was subject to one- tailed test of statistical significant. The correlation was significant at $p < 0.000$ probability level. Correlation coefficient (r) was interpreted according to the guidelines recommend by Cohen (1988), i.e. small ($r = .10 - .29$), medium/moderate ($r = .30 - .49$) and large

($r = .50 - 1.0$). The results obtained from Table 5 revealed large to moderate negative association between intention to quit with both motivation ($r = -.470$, $n = 203$, $p < 0.000$) and satisfaction ($r = -.792$, $n = 203$, $p < 0.000$). Subsequently multiple regression was employed to examine the influence of motivation, and job satisfaction on intention to quit and the results are displayed on Table 6.

Table 6: Regression of motivation and job satisfaction on intention to quit

	<i>B</i>	<i>SEB</i>	β	<i>T</i>	<i>p-value</i>
Motivation	-0.174	0.065	-0.128	2.552	0.008
Job satisfaction	-0.987	0.065	-0.732	6.159	0.000
Constant	6.795	0.205		35.85	0.000

Source: Fieldwork, 2014

$R^2 = 0.639$; Adjusted $R^2 = 0.636$; F-value = (177.3), $P < 0.05$

On the overall, the regression model show that motivation and satisfaction significantly explains more than half (63%) of the variation in teachers intention to quit. However, the explanatory variables did not exert same level of influence on the dependent variable. From the Table 6, job satisfaction made the most significant but negative contribution to intention to quit ($\beta = -0.732$, $p < 0.00$) implying that when job satisfaction is high, intention to quit will be low and the reverse is true. Therefore, the hypothesised statement that: there is a significant negative relationship between job satisfaction and intention to quit was accepted. This observation supports the results of Mbah and Ikemefuna (2012) when they sought to see the relationship between job satisfaction and employee's turnover intention in Total Nigeria and the finding of the study showed that, the greater the job satisfaction the less likely is the turnover intention.

Motivation made the least contribution but significant to intention to quit was ($\beta = -0.128$, $p < 0.01$). Perhaps, motivation exerted less impact owing to the fact that job satisfaction moderates the relationship between employee motivation and intention to quit. This is because one's level of satisfaction as stated in the conceptual model is dependent on motivation and so

is job commitment. Consequently, it suggests that the more motivated an individual will be, the more satisfied and committed to the job he or she will be thus intention to quit.

V. CONCLUSION

From the findings of this study, we conclude that opportunity for training and development, job security, recognition and reward and salary are the main motivators of teachers in the Tamale Metropolis. Job satisfaction significantly impacts teachers' intention to quit. Therefore, retain employees is to ensure that they are satisfied with their job. Hence, it indicates that more teachers feel that their working conditions are well improved, the higher the probability of them staying.

Based on the findings of this study, it is recommended that teachers should be motivated by government and its agencies responsible for education as much as possible to retain them in the teaching profession to improve the quality of instruction given in schools. Better conditions of service should be provided by Ghana Education Service as an agency of government to motivate people to enter into teaching. School authorities particularly school administrators; Parents Teachers Associations

(PTAs), School Management Committees (SMCs) should encourage teachers and give them some resources through financial support, organization of regular staff meetings to share views and concerns, and development programmes to increase job satisfaction and to promote teacher efficiency. In-service training, refresher courses, and on the job training should be organised regularly by Ghana Education Service to help upgrade teachers to improve upon their professional, pedagogical, and personal skills. This would help to give the needed and expected recognition of teachers from the community. The study revealed that job satisfaction is a major means with which teachers can be retained, hence needed efforts should be made to ensure that teachers are satisfied with their job so as to retain them. In bid to ensuring teachers satisfaction, the most refereed motivational packages of teachers unravelled by the study can be used as benchmarks.

Limitations and Directions for Future Research

This research is subject to the generic limitations of survey research. The research also focused on one district within the region and only motivation and job satisfaction was looked as factors associated to intention to quit. It is therefore not generalisable to entire teaching service in the region. Thus, future research could also be replicated to other sectors, including a comparison between the private and public sector schools. In addition, future research framework and hypothesis developed for this study could be expanded to include personality factors and psychological contract as an antecedent of job satisfaction and motivation.

REFERENCES

- [1] Agnes, M. (1999). Webster's New World College Dictionary (4th edition). New York, NY: Macmillian USA
- [2] Ahmad, A., & Omar, Z. (2010). Perceived family – supportive work culture, affective commitment and turnover intention of employees. *Journal of American sciences*, 6 (20), 60-80.
- [3] Ali, N. (2007). Factors affecting overall job satisfaction and turnover intention. *Journal of Managerial Sciences*, 2(2), 239-252.
- [4] Anderson, L. & Olsen, B. (2005). Studying the career pathways of urban teachers in Los Angeles: Who stay, Who leaves, Who shifts into other urban education work? Lo Angels: Institute for democracy, Education and Access, Center XUCLA.
- [5] Asif, S., Hassan, G. & Ramzan, M. (2013). Impact of motivation on employee turnover in the Telcom sector of Pakistan. *Journal of Business Studies Quarterly*: Vol. 5 No 1
- [6] Bateman, J. (1991). Test Generation and Systematic Functional Linguistics. *Communication in Artificial Intelligence Series*. Frances Printer Publisher Ltd.
- [7] Bateman, T. S., & Strasser, S. (1984). A longitudinal analysis of the antecedents of organizational commitment, *Academy of Management Journal*, 27, 95-112.
- [8] Borda, R. G., & Norman, I. J. (1997). Factors influencing turnover and absence of nurses: a research review. *International Journal of Nursing Studies*, 34(6), 385-394.
- [9] Brookfield H. B. (1998). The impact of flexible benefits plans on job satisfaction, organizational commitment and turnover intention", *Benefits Quarterly*, 10 (1):84-90.
- [10] Cascio, W. F. (2006). *Managing human resources: Productivity, quality of work life, profits* (5th ed.). New York: McGraw-Hill.
- [11] Cohen, J. (1988). *Statistical power analysis for behavioural sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- [12] Cohen, A. (2007). Commitment before and after: An evaluation and reconceptualization of organizational commitment. *Human Resource Management Review*, 17(3), 336-354.
- [13] Cooper, D. R. & Schindler, P. S. (2000). *Business research method* (7th ed.). New York: MacGraw – Hill.
- [14] Currvan, D. B. (1999). The causal order of job satisfaction and organizational commitment in models of employee turnover. *Human Resource Management Review*, 9(4), 54-82.
- [15] Cranny, C.J., Smith, R.C. & Stone, E.F. (1992). *Job satisfaction: How people feel about their jobs and how it affects their performance*. New York: Lexington
- [16] Devellis, R. F. (2003). *Scale development: Theory and application* (2nd Ed.). Thousand Oaks, California: Sage Publications.
- [17] Dubinsky, A. J., Micheals, R. E., Kotabe, M., Chae, U. L., & Hee-Cheol, M., (1990). Influence of role stress on industrial sales people's Work outcomes in the United States, Japan, and Korea. *Journal of International Business Studies*, First Quarter, 77-99.
- [18] The Ghanaian Times. (2014). The education ministry must not allow this bomb to explode., pp 4, No. 17,197.
- [19] Fraenkel, J. R. & Wallen, N. E. (2009). *How to Design and Evaluate Research in Education* (7th ed.). New York: MacGraw – Hill.
- [20] Ghana National Association of Teachers (2010). *Teacher Attrition in Ghana: Results of a Questionnaire Survey 2009*.
- [21] Getahun, S. B., & Sims, Hummer, D. (2008). Job satisfaction and organizational commitment among probation and parole officers: A case study. *A Professional Journal*, 3(1), 87-107.
- [22] Grissmer, D., & Kirby, S. (1997). Teacher turnover and teacher quality, *Teacher College Record*, 9(9), 45–56.
- [23] Guarino, C., Santibanez, L., Daley, G. & Brewer, D. (2004). A review of the research literature on teacher recruitment and retention, Technical report No. TR- 164-EDU, Los Angeles: RAND Corporation.
- [24] Hellriegel, D., Slocum, J. W., & Woodman, R. W. (2001). *Organizational behaviour* (9th ed.), Ohio: South-Western Publishing.
- [25] Howell, D. C. (2007). *Statistical methods for psychology* (6th Ed.). Belmont, CA: Thompson Wadsworth.
- [26] Ingersoll, R. M. & Smith, T.M. (2003). Is there really a teacher shortage? Seattle, WA, Center for study of teaching and policy.
- [27] Ingersoll, R. M. & Smith, T. M. (2003). The wrong solution to teachers' shortage. *Educational Leadership*, 60 (8), 30 – 33.
- [28] Ingersoll, R. M. (2003). Is there really a teacher shortage? Center for the Study of Teaching and Policy and the Consortium of Policy Research in Education. University of Washington.
- [29] Irving, P. G., Coleman, D. F., & Cooper, C. L. (1997). Further assessment of a three component model of occupational commitment: Generalizability and differences across occupation. *Journal of Applied Psychology*, 444-452.
- [30] Jacobs, E., & Roodt, G. (2007). The development of a knowledge sharing construct to predict turnover intentions in Hussain, T. & Asif, S. (2012). Is employees' turnover intention driven by organizational commitment and perceived organizational support? *Journal of Quality and Technology Management* Vol. VIII, Issue II pp.01–10
- [31] Jonathan, H., Thibeli, M., & Darroux, C. (2013). Impact investigation of organisational commitment on intention to leave of public secondary school teachers in Tanzania. *Developing Country Studies*, 3(11), 78-91.
- [32] Keith, T. Z. (2006). *Multiple regression and beyond*. Boston, MA: Pearson.
- [33] Kirby, S. N., & Grissmer, D. W. (1993). Teacher attrition: Theory, evidence, and suggested policy options. Washington DC: U.S. Department of Education (ERIC Document Reproduction Service No. ED 364-533).
- [34] Koustelios, A. D. (2001). Personal characteristics and job satisfaction of Greek teachers. *International Journal of Educational Management*, 15(6), 354–358.
- [35] Krejcie, R. V. & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement* 30, 607-610.
- [36] Lambert, E. G. (2004). Organizational citizenship behaviour and commitment among correctional staff. *Criminal Justice and Behavior*, 35(1), 67-98.
- [37] Latham, G. P., & Pinder, C. C. (2005). Work motivation theory and research at the dawn of the twenty-first century. *Annual Review of Psychology*, 56, 485-516.

- [38] Landan, J., & Hammer, T. H. (1986). Clerical employees' perceptions of interaction organizational career opportunities. *Academy of management*, 29 (2), 385 – 404.
- [39] Lau, C. M. & Chong, J. (2002). The effects of budget emphasis, participation and organizational commitment on job satisfaction: Evidence from the financial services sector. *Advances in Accounting Behavioural Research*, 5, 183-211.
- [40] Lee, T. W., & Mitchell, T. R. (1994). An alter employee turnover. *Academy of Management*, 9 (2), 86-116.
- [41] Martin, M. J. (2011). Influence of Human Resource Practices on employee intention to quit. (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg, Virginia.
- [42] Malhorta, N. & Mukerjee, A. (2004). The relative influence of organizational commitment and job satisfaction on service quality of customer contact employees in banking call centre. *Journal of Services Marketing* 18(3), 162-174.
- [43] Mba, S. E., & Ikemefuna, C. O. (2012). Job satisfaction and employees' turnover intentions in total Nigeria plc. in Legos state. *International journal of humanities and social sciences*, 2(14).
- [44] McDonald, D. & Makin, P. (2000). The psychological contract, organisational commitment and job satisfaction of temporary staff. *Leadership and Organizational Development Journal*, 21 (2), 84 – 91.
- [45] Meyer, J. P., & Allen, N. J. (1991). A three-component conceptualization of organizational commitment. *Human resource management review*, 1(1), 61-89.
- [46] Ministry of Education and Ghana education Service.
- [47] Mowday, R., Porter, L., & Steers, R. (1982). *Employee organisational linkages: The psychology of commitment, Absenteeism and Turnover*. New York: Academic.
- [48] Mowday, R. T., Koberg, C. S., & McArthur, A. W. (1984). The psychology of the withdrawal process: A cross-validation test of Mobley's intermediate linkages model of turnover in two samples. *Academy of Management Journal*, 27(1), 79-94.
- [49] Mueller, C.W., Boyer, E.M., Price, J.L., & Iverson, R.D. (1994) Employee attachment and non-coercive conditions at work: The case of dental hygienists. *Work and Occupations*, 21, 179-212.
- [50] Murnane, R., Singer, J., Willett, J., Kemple, J., & Olsen, R. (1991). *Who will teach? Policies that matter*. Cambridge, MA: Harvard University Press.
- [51] Randhawa, G. (2007). Relationship between job satisfaction and turnover intentions: An empirical analysis. *India Management Studies Journal*, 11, 149-159.
- [52] Richey, R. W. (1963). *Planning for teaching: An introduction to education*. London: McGraw-Hill Book Company Inc.
- [53] Rosin, H. M., & Korabik, K. (1991). Workplace variables, affective responses, and intention to leave among woman manager. *Journal of Occupational Psychology*, 64, 317-330.
- [54] Samad, S. (2006). The contribution of demographic variables: job characteristics and job satisfaction on turnover intention. *Journal of International Management Studies*, 1 (1), 45-89.
- [55] Samuel, M. O. & Chipunza, C. (2003). Attrition and retention of senior academics at institution of higher learning in South Africa: The Strategies of Social Sciences, 35 (2), 97 – 109.
- [56] Samuel, M. O., & Chipunza, C. (2009). Employee retention and turnover: Using motivational variables as a panacea. *African journal of business management*, 3(8), 410-415.
- [57] Sarantakos, S. (2007). *A tool kit for quantitative data analysis*. Palgrave: MacMillan Hampshire.
- [58] Smith, A., & Robinson, P. (2003). *Factors affecting teachers' decisions to leave the profession*. London: McGraw-Hill Book Company Inc.
- [59] Smith, P. J. & Cronje, D. J. (2002). *Management principles: A contemporary edition for Africa*. Londn: McGraw-Hill Book Company Inc.
- [60] Spector, P. E. (1985). Measurement of human service staff satisfaction: Development of job satisfaction survey. *American Journal of Community Psychology*, 13 (6), 693–713.
- [61] Steer, R. M., & Black, J. S. (1994). *Organizational behaviour*, (5th ed). New York: Harper Collins College.
- [62] Stockard, J., & Lehman, M. B. (2004). Influences on the satisfaction and retention of first year teachers: The importance of effective school management. *Education Administration Quarterly*, 40(2), 742–771.
- [63] UNESCO institute for statistics on Ghana.
- [64] Tett, R. P., & Meyer, J. P. (1993). Job satisfaction, organizational commitment, turnover intention, and turnover: path analyses based on meta-analytic findings. *Personnel psychology*, 46(2), 259-293.
- [65] Tewksbury, R. (2009). Qualitative versus quantitative methods: Understanding why qualitative methods are superior for criminology and criminal Justice. *Journal of theoretical and philosophical criminology*, 1(1), 65-90.
- [66] Walker, W. D., Garton, B. L., & Kitchel, T. J. (2004). Job satisfaction and retention of secondary agriculture teachers. *Journal of Agricultural Education*, 45(2), 28-57.
- [67] Yammarino, F. J., Skinner, S. J. & Childers, T. L. (1991). Understanding mail survey response behavior: A meta – analysis. *Public Opinion Quarterly*, 55, 613–539.
- [68] Zahra, S., Irum, A., Saad, M. & Chishti, A. (2013). Job satisfaction and faculty turnover intentions: A case of Pakistani Universities. *Journal of Business and Management*, Vol. 9, Issue 2

AUTHORS

First Author – Isaac Kosi, School of Business, University of Cape Coast, Cape Coast, Tel: 233-24-460-1968, E-mail: ikosi@ucc.edu.gh

Second Author – Ibrahim Sulemana, School of Business University of Cape Coast, Cape Coast, Tel: 233-27-224-7944, E-mail: ibrahimsamuel@rocketmail.com

Third Author – Janet Serwah Boateng, Institute for Development Studies, University of cape Coast, Cape Coast, Tel: 233-24-465-8385, Email: jboateng@ucc.edu.gh

Fourth Author – Robert Mensah, Methodist University College Accra, Tel: 233-24-463-6094, Email: robertandmensah@yahoo.com

Regeneration potential and distribution pattern of tree species along altitudinal gradient in Central Himalaya

J P Mehta*, Shreshthamani* and V P Bhatt**

*Department of Botany, HNB Garhwal University Srinagar Garhwal, India

**Department of Botany, Govt P G College Gopeshwar, Chamoli, India

Abstract- The present paper reports the regeneration potential and distribution pattern of natural forest in Taknaur Reserve Forest of Uttarkashi forest division of Garhwal Himalaya, Uttarakhand. A total of 29 tree species were recorded from the area. Density and distribution of seedlings, saplings and trees were assessed along the gradient of altitude using the quadrat size 1x1m (for seedlings) 5x5m (for saplings) and 10x10m (for trees). The numbers of individuals, frequency were recorded and height of the species in the quadrat at 100m drops in altitude. Seedling densities varied markedly among the species and altitude. Lower elevation was dominated with *Pinus roxburghii* and *Quercus leucotrichophora* was found co-dominant species whereas, *Buxus wallichiana* and *Quercus floribunda* was dominant and *Taxus baccata* was co-dominant species in site two (1900-2500m asl). While upper elevations were dominated by *Buxus wallichiana*, *Quercus floribunda* and *Abies pindrow*, *Cedrus deodara*, respectively, for site 3rd and 4th. However, the highest (10000 ha⁻¹) seedling density, was reported for *Pinus roxburghii* at site 1 followed by *Cedrus deodara* (9000 individuals ha⁻¹) at site 2, *Buxus wallichiana*, *Taxus baccata*, *Quercus floribunda* *Abies pindrow* and *Cedrus deodara* (4000 individual ha⁻¹ of each species) at site 3 and 4, respectively. It is remarkable that economically and ecologically valued species *Acer accuminatum*, *Ulmus wallichiana*, *Betula utilis* *Acer oblongum* which are already in vulnerable in their status were found absent in seedling stage. These species were also reported as regularly distributed in tree and sapling stratum, which is very alarming for the conservation point of view. In tree layer the most of the species (65.16%) were distributed contagiously and remaining (34.84%) were distributed randomly.

Index Terms- Himalaya, Taknaur forest, regeneration potential, *Acer accuminatum*, *Acer oblongum*, *Ulmus wallichiana*, *Taxus baccata*.

I. INTRODUCTION

Regeneration is the key feature of the forest dynamics, progress and restoration of degraded forest lands. It depends on number of seedlings, saplings and their distribution pattern in the region. If seedlings and saplings are less than the mature trees, it indicates declining trends in forest and regeneration will be poor. Forest reveals variation in pattern of regeneration both through differences in their constituent species and the environmental variables in which they grow (Demel, 1997a; Denslow, 1987; Whitmore, 1996). Regeneration of any species is confined to a peculiar range of habitat conditions and the

extent of those conditions is a major determinant of its geographic distribution (Grubb 1977). Trees regenerate one or more pathways: seed rain (recently dispersed seeds), the soil seed bank (dormant seeds in the soil), and the seedling bank (established, suppressed seedlings in the understory) and coppice (root/shoot sprouts of damaged individuals (Demel, 1997b; Demel and Granstrom, 1995; Garwood, 1989; Getachew *et al.* 2002; Whitmore 1996). Sustainable forest utilization is only possible if adequate information on the regeneration dynamics and factors influencing important canopy tree species are available. Thus, study of regeneration of forest trees has important implications for the management of natural forests, and is one of the thrust areas of forestry.

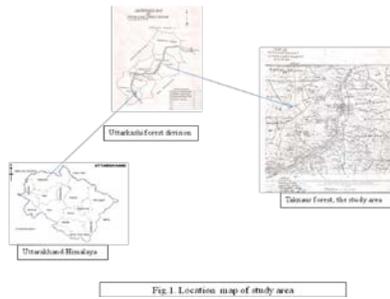
The population structure, characterized by the presence of sufficient population of seedlings, saplings and adults, indicates successful regeneration of forest species (Saxena and Singh, 1984), and the presence of saplings under the canopies of adult trees also indicates the future composition of a community (Austin, 1977). Regeneration status of trees can be predicted by the age structure of their populations (Khan *et al.*, 1987; Vablen *et al.*, 1979 and Tripathi and Khan 2007).

Studies on population structure and density of major canopy tree species can help to understand the status of the regeneration of species and thereof, management history and ecology of the forest (Alvarez-Buyalla *et al.*, 1996; Foster 1980; Harper 1977; Hubble and Foster 1986; Lykke, 1993; Saxena *et al.*, 1984). Plant population structure shows whether or not the population has a stable distribution that allows continuous regeneration to take place (Enright and Watson, 1991; Rao *et al.*, 1990). Regeneration is the process of silvigenesis by which trees and forests survive over time (Bhuyan *et al.*, 2003). If regeneration takes place continuously, then, the distribution of the species cohorts would show reverse J shape curve which is an indicator of healthy regeneration (Demel, 1997a; Silvertown, 1982). Such population structure are common in natural forests where external disturbances are limited (Getachew *et al.* 2002; Feyera, 2006).

Seedling densities in forest understories are dynamic and rates may vary among species and in gap and shade environments (Bazzaz, 1991). The rates also vary due to mortality, which could include abiotic stresses such as light, drought and biotic factors that includes herbivores, diseases and competition (Augsburger, 1984). Information on tree seedling story can provide option for forest development through improvement in recruitment, establishment and growth of the desired species (Swaine 1996). Thus regeneration studies have significant applications on the management, conservation and restoration of degraded natural forest.

II. MATERIAL AND METHODS

Study Area



The study has been carried out in Taknaur reserve forest of Uttarkashi forest division of Central Himalaya. Geographically the forest division extends from 30° 24' 30" to 31° 27' 30" N latitude and 78° 09' 40" to 79° 25' 05" E longitude and occupies an area of about 224370.60 ha while the study area stretches between 30° 49' 41" to 30° 54' 06" N latitude and 78° 35' 08" to 78° 40' 33.7" E longitude and covers an area of about 66755.90 ha, which is 29.75% of the division, while altitudinally, the area ranges from 1280 m asl to 3500 m asl.

Geologically, the study area falls in the middle and greater Himalayan zone, which is mainly comprised of unfossiliferous sedimentary rocks of various ages from Precambrian to Paleozoic (Valdia, 1976). Climatic conditions are generally dry with low annual precipitation, but there is heavy rainfall during the monsoon from late June to early September. Prevailing mist and low cloud during the monsoon keeps the soil moist, hence the vegetation is lush than is usual in the inner areas. The area is usually snow-bound for six to seven months between late October and late March.

For understanding the study area, it was divided in four sites along gradients of altitudes as **Site 1 (1280-1900m asl)**, **Site 2 (1900-2500m asl)**, **Site 3 (2500-3000m asl)** and **Site 4 (3000-3500m asl)** as per its geographical condition and vegetation type **Fig. 1**.

Methodology

Tree, sapling and seedling survey work were conducted during October 2008 to July 2010 and data were collected from the different forest types based on stratified random sampling method. For the purpose of this study, the terms seedling, sapling and tree were defined as plants with heights up to 150cm, between 150 and 300cm and above the 300cm respectively as per Getachew *et al.* 2002. The vegetation data were quantitatively analyzed by laying the quadrats at different sites, 10x10m for trees, 5 × 5 m for sapling and 1 × 1 m size quadrates were laid down for seedlings randomly at each site separately for abundance, density, frequency following the methods discussed by Curtis and Cottom (1956).

III. RESULTS

Through the exhaustive phyto-sociological surveys of different sites of Taknaur forest the comprehensive data were collected and results were summarized in table 2, which describes species diversity story of the forest. A total of 29 tree

species were recorded among them *Pinus roxburghii*, *Quercus leucotrichophora* (at Site 1), *Buxus wallichiana*, *Cedrus deodara*, *Quercus floribunda*, *Taxus baccata* (at site 2), *Buxus wallichiana*, *Cedrus deodara*, *Pinus wallichiana*, *Acer accuminatum* (at site 3) and *Abies pindrow*, *Cedrus deodara*, *Quercus semicarpifolia*, *Picea smithiana* (at site 4) were found dominant species. Which clearly categories the forest in four forest types along the altitudinal gradients. The general features of the area can understood from the table no 1. Thus, study area, the Taknaur reserve forest can be categorized in four forest types viz (1) Pine-oak forest, (2) Oak-mixed forest (3) Oak-conifer forest and (4) Conifer forest. The forest represents generally conifer-oak mixed type forest.

Table: 1 General characteristics of the study area of Taknaur forest.

Sites	Altitude	Aspect	Dominant species	Forest types
Site 1	1280-1900	South-west	<i>Pinus roxburghii</i> , <i>Quercus leucotrichophora</i> and <i>Rhododendron arboreum</i>	Pine-oak forest
Site 2	1900-2500	North	<i>Buxus wallichiana</i> , <i>Cedrus deodara</i> <i>Quercus floribunda</i> , <i>Lyonia ovalifolia</i> , and <i>Pinus wallichiana</i>	Mixed oak- conifer forest
Site 3	2500-3000	West	<i>Quercus floribunda</i> , <i>Swida microphylla</i> <i>Lyonia ovalifolia</i> , <i>Cedrus deodara</i> , <i>Pinus wallichiana</i> and <i>Picea smithiana</i>	Mixed broad leaved conifer forest
Site 4	3000-3500	East	<i>Abies pindrow</i> , <i>Picea smithiana</i> , and <i>Cedrus deodara</i>	Conifer forest

Table: 2. Regeneration potential and distribution pattern along gradient of altitudes and aspects of Taknaur forest of Uttarakashi forest division in Garhwal Himalaya.

Name of species	Gradients of elevation							
	1280-1900 m		1900-2500 m		2500-3000 m		3000-3500 m	
	Density (ha ⁻¹) Tree/Sap /Seedlings	A/F Ratio Tree/Sap /Seedlings						
<i>Pinus roxburghii</i>	490/640/1000 0	0.30/0.20/0.62						
<i>Quercus leucotrichophora</i>	190/180/4000	0.47/0.23/0.10						
<i>Lyonia ovalifolia</i>	130/260/3000	0.14/0.33/0.03	140/180/3000	.028/.01/----	70/50/2000	.028/.024/.05	90/120/3000	.04/.024/.075
<i>Rhododendron arboreum</i>	90/120/----	0.22/0.15/----	60/60/----	.06/.07/.075				
<i>Buxus wallichiana</i>	80/80/2000	0.80/0.50/0.20	460/560/8000	.28/.17/.09	210/180/4000	.084/.036/.04		
<i>Taxus baccata</i>	90/140/3000	0.90/0.70/0.30	260/480/8000	.07/.04/.021	140/260/4000	.056/.02/.025	150/160/3000	.025/.02/.03
<i>Abies pindrow</i>			180/240/5000	.11/.03/.053	100/120/----	0.25/0.15/----	180/180/4000	.05/.04/.025
<i>Acer acuminatum</i>			70/80/----	.07/0.10/----	40/60/----	.10/.30/----	20/40/----	.20/.20/----
<i>Pinus wallichiana</i>			180/220/6000	.03/.022/.03	160/180/4000	.03/.036/.25		
<i>Quercus semecarpifolia</i>			230/200/6000	.04/.015/.024	130/220/3000	.035/.02/.075	130/140/3000	.028/.014/.07
<i>Swida macrophylla</i>			60/40/----	.15/.20/----	30/40/----	.075/.20/----		
<i>Quercus floribunda</i>			280/420/5000	.07/.058/.02	150/260/4000	.04/.03/.025	110/140/3000	.13/.076/.075
<i>Cedrus deodara</i>			290/360/9000	.03/.02/.018	180/260/3000	.027/.02/.03	180/160/4000	.037/.015/.04
<i>Aesculus indica</i>			30/20/----	.03/.10/----	110/20/----	.02/.10/----	40/60/1000	.10/.075/.10
<i>Salix babylonica</i>			50/80/----	.50/.10/----	20/----/----	.20/.025/----		
<i>Juglans regia</i>					20/40/----	.20/.20/----	30/40/1000	.075/.20/.10
<i>Fraxinus micrantha</i>					30/20/1000	.30/.10/.10	4/40/----	.10/.20/----
<i>Alnus nepalensis</i>			50/80/1000	.12/.10/.10	20/20/----	.20/.10/----		
<i>Ilex dipyrena</i>					40/40/1000	.10/.20/.10	40/60/1000	.10/.30/.10
<i>Acer oblongum</i>			30/30/2000	.30/.04/.20	20/20/----	.05/.10/----		
<i>Betula anoides</i>			120/100/3000	.03/.02/.075	30/40/----	.03/.05/----		
<i>Populus ciliata</i>					10/20/----	.10/.10/----	30/20/----	.075/.10/----
<i>Toona serrata</i>			20/40/----	.05/.20/----	20/20/----	.20/.10/----		
<i>Cupressus torulosa</i>					30/40/----	.30/.20/----	50/60/1000	.13/.075/.10
<i>Picea smithiana</i>					20/20/----	.20/.10/----	70/60/1000	.05/.075/.10
<i>Carpinus viminea</i>					10/20/----	.10/.10/----		
<i>Symplocos chinensis</i>					30/20/----	.075/.10/----		
<i>Ulmus wallichiana</i>					30/40/----	.75/.05/----		
<i>Betula utilis</i>							50/60/----	.05/.075/----

The seedlings of *Pinus roxburghii* showed the concentration at lower elevation (1280m - 1900m asl) only and does not occur throughout the elevations in the study area. Seedling densities varied considerably with altitude ranging between 530 individuals ha⁻¹ at 1900m and 10000 individuals ha⁻¹ at 1280m asl. Of the total seedlings 57% were less than 50cm. in height. Seedlings of *Taxus baccata* showed distinct altitudinal concentration between 1500m to 3000m asl. Seedling densities increased (8000 individuals ha⁻¹) at the elevation of 2500m while it was decreased progressively (3000 individuals ha⁻¹) at 3200m asl. The highest seedling density was recorded at 2500m asl. It was found throughout the altitudinal gradients in contagious distribution in the study area.

Cedrus deodara was found in tremendous occurrence (9000 individuals ha⁻¹) in seedlings stratum at the site 2 (1900m-2500m) but lower at higher elevations (Site 3 & 4). *Buxus wallichiana* (8000 individuals ha⁻¹) was found co-dominant, whereas, *Rhododendron arboreum* (3000 individuals ha⁻¹) was showed very poor performance in new generation at site 2.

Seedlings of *Lyonia ovalifolia* were not concentrated at any elevation and occurred across the altitudinal ranges of study area. Of all the seedlings, 45% were less than 50 cm in height.

The seedling densities of different species at site 1 showed that it was young new growing Pine-oak forest. The highest seedling density (10000 individuals ha⁻¹) was recorded for *Pinus roxburghii* followed by *Quercus leucotrichophora* and *Taxus baccata* (4000 and 3000 individuals ha⁻¹ respectively), while, *Buxus wallichiana* showed lowest (2000 individuals ha⁻¹) of seedlings.

Sapling densities and distribution pattern of different species at different altitude was recorded different from their mature plants. *Pinus roxburghii* (640 individuals ha⁻¹) was found dominant with contagious distribution followed by *Rhododendron arboreum* (260 individuals ha⁻¹) whereas least sapling density was observed for *Buxus wallichiana* (100 individuals ha⁻¹) at site first (1280-1900m asl). At second site (1900-2500m asl) sapling density was highest for *Buxus wallichiana* (560 individuals ha⁻¹) followed by *Taxus baccata* (480 individuals ha⁻¹) as co-dominant species. Site third had different story in compared to their mature trees that is *Quercus floribunda*, *Taxus baccata* and *Cedrus deodara* (260 individuals ha⁻¹ of each species) were the dominant species and showed same sapling densities whereas their tree stratum was little varying. *Lyonia ovalifolia* and *Aesculus indica* (20 individuals ha⁻¹) was least occurred plant species at this site. However, the site fourth was giving good regeneration potential in their second generation as *Abies pindrow* (180 individuals ha⁻¹) was dominating along with *Cedrus deodara* and *Taxus baccata* (160 individuals ha⁻¹ of each species) co-dominating species. *Populus ciliata* was found with very poor performance (20 individuals ha⁻¹) at this site.

Densities of different trees at different altitude was also varied as *Pinus roxburghii* 490, *Quercus leucotrichophora* 190 individuals ha⁻¹ at site 1, while, *Buxus wallichiana* showed least (80 individuals ha⁻¹) density at this site. Increasing with altitude that is site second (1900-2500m) the reverse trends were shown as *Buxus wallichiana* expressed highest density (460 individuals ha⁻¹) followed by *Cedrus deodara* (290 individuals ha⁻¹) whereas least was shown by *Aesculus indica* (30 individuals ha⁻¹). At higher elevational range (2500-3000m) *Buxus wallichiana* also

maintained its dominancy with 210 individuals ha⁻¹ which is again followed by *Cedrus deodara* (180 individuals ha⁻¹) and poorly occurring species was *Populus ciliata* (10 individuals ha⁻¹). The site fourth (3000-3500m asl) had a different tree composition with dominant elements of *Abies Pindrow*, *Cedrus deodara* (180 individuals ha⁻¹) and *Taxus baccata* (150 individuals ha⁻¹) as a co-dominant species. Here *Acer accuminatum* was least occurred (20 individuals ha⁻¹) plant species.

IV. DISCUSSION

Seedling densities varied significantly among species. Seedling densities were highest for *Pinus roxburghii*, *Cedrus deodara*, *Abies pindrow*, *Taxus baccata* and *Quercus floribunda* at different sites due to their optimum requirements of climatic, geographic and edaphic conditions and high reproductive potential of mother trees. However, 42-61% of the seedling populations of several species in Ethiopian forest were lost annually due to drought, disturbances and herbivory damage (Getachew 2008). *Ilex dipyrrena*, *Populus ciliata*, *Picea smithiana*, *Juglans regia* and *Aesculus indica* had the lowest seedling density which could be attributed due to unfavorable climatic conditions, anthropogenic disturbances, other biotic interferences and low reproductive performance of the mother trees. The pioneering species *Alnus nepalensis*, *Pinus roxburghii* and *Quercus leucotrichophora* were concentrated only at lower elevation whereas *Betula utilis* was concentrated only at higher elevation. This is very clear indications of topographic, geographic and climatic restrictions of the species.

The distribution of seedlings along elevational gradients also showed marked variations among species. *Taxus baccata*, and *Lyonia ovalifolia* showed wide distributions and occurred along entire elevational range in the forest. On the other hand *Pinus Roxburghii*, *Quercus leucotrichophora* restricted to lower elevation (1280-1900m); *Betula utilis* was found restricted to higher elevation (3000-3500m) only whereas, *Ulmus wallichiana* was concentrated only at middle elevation (2500-3000m). Maximum species were distributed in contagious pattern across the altitudinal ranges. Odum (1971) have emphasized that contagious distribution is the commonest pattern in nature. Kumar and Bhatt (2006) also reported contagious distribution pattern in foot-hills forests of Garhwal Himalaya. At the upper elevation, relatively humid climatic conditions would restrict the distribution of some species.

The data of densities and distribution of trees, sapling and seedlings (table 2) clearly explains that the site second is naturally healthy conifer-mixed oak forest with high regeneration status of *Cedrus deodara* folloed by *Taxus baccata* and *Buxus wallichiana*. But at the same time it is very negative sign that the valuable species *Acer accuminatum* has no regeneration mark in the area.

Tree densities were varying along the altitude but the trends were very similar to previous studies in the Himalaya. Bargali *et al.* (1987) has described the values of tree density ranging from 490 to 1640 individual ha⁻¹ in Kumaun forest. Pangtey *et al.* (1989) reported the density values of trees ranging from 140 to 750 individual ha⁻¹ in Pindari catchments forest. Kumar *et al.*

(2001) reported density values of tree ranged 652 to 1028 individual ha⁻¹.

The absence of seedlings of *Acer accuminatum*, *Acer oblongum*, *Betula utilis*, *Ulmus wallichiana*, and *Swida macrophylla* may be partially attributed to the absence of a conducive environment for germination of their seeds such as severe disturbance of the canopy and forest soils. Climatic conditions and biotic interference influence the regeneration of different species in the vegetation. Higher seedling density values reduced to perform as sapling stage due to biotic disturbance and competition for space and nutrients Kumar and Bhatt (2006). In previous study similar results were obtained for several species in Ethiopian forest by Getachew and Demel 2005b.

Among all the 29 tree species occurring in the study area, 10 tree species as *Acer accuminatum*, *Acer oblongum*, *Ulmus wallichiana*, *Betula utilis*, *Carpinus viminea*, *Symplocos recemosus*, *Populus cilata*, *Toona serrata*, *Salix babylonica* and *Swida macrophylla* were found completely absent in seedling stratum. This clearly says that there is no regeneration in these species. Since, these data were on the basis 2 years observations, therefore straightly it cannot be concluded that in future these species will remain absent in the area but it is essentially alarming sign of vulnerability of these species. Because out of these 10 species *Acer accuminatum*, *Acer oblongum*, *Ulmus wallichiana*, *Betula utilis* are already in vulnerable in IUCN Red data book and their mature tree and saplings are also not well in distribution and densities in the investigated area, they are in regular distribution. Therefore, it is evident that these species requires urgent conservation measures in the area for their restoration. *Acer accuminatum*, *Acer oblongum*, *Ulmus wallichiana*, *Betula utilis* are not important only due to their conservation status but also important due to their economic and ecological values in the ecosystem.

The species that requires high conservation in Uttarkashi forest division were *Betula utilis*, *Acer oblongum*, *Acer accuminatum*, *Ulmus wallichiana*. Regeneration problem was largely attributed to human disturbances, lack suitable habitat for seeds to germinate or problem associated with producing mature and fertile seeds. On the other hand, high seedling densities or adeptive defenses to herbivory were common attribute to healthy regenerating species.

Based on our results, the following recommendations are forwarded as option for sustainable forest management of the forest division. i) Initiate *in-situ* conservation efforts for *Betula utilis*, *Acer oblongum*, *Acer accuminatum*, *Ulmus wallichiana*, including restrict protection of remaining mother trees. ii) Promote sustainable utilization of trees through traditional knowledge based decision system such as population growth models of each species. iii) Study of reproductive ecology of the species including pollination, seed production, dispersal and germination.

ACKNOWLEDGEMENTS

Authors are thankful to the editorial board and reviewers to improve the manuscript.

REFERENCES

- [1] Alvarez-Buyalla, E.R., Garcia-Barrios, R., Lara-Moreno, C., Martinez-Ramos, M. Demographic and genetic models in conservation biology: application and perspectives for tropical rain forest tree species. *Ann. Rev. Ecol. Syst.* 1996, 27, pp. 387-421.
- [2] Augspurger, C.K. Pathogen mortality of tropical tree seedlings: experimental studies of effect of dispersal distance, seedling density and light conditions. *Oecologia.* 1984, 61, pp. 211-217.
- [3] Austin, M.P. Use of ordination and other multivariate descriptive methods to study succession. *Vegetatio*, 1977, 3, pp. 165-175.
- [4] Bargali, S.S., Tewari, J.C., Rawat, Y.S. and Singh, S.P. Woody vegetation in a high elevation blue pine mixed oak forest of Kumaun Himalaya. In: Pangtey YPS and Joshi SC (eds.). *Western Himalaya: Environment, Problems and Development.* Gyanodaya Prakashan, Nainital, 1987, 1, pp.121-155.
- [5] Bazzaz, F. Regeneration of tropical forests: physiological responses of pioneer and secondary species, In: Gomez-Poma, A; Whitmore, T; Hadley, M (Eds), *Rain forest regeneration and management.* Parthenon Publishing, UNESCO, Paris, 1991, pp. 91-118.
- [6] Bhuyan, P., Khan, M.L. and Tripathi, R.S. Tree diversity and population structure in undisturbed and human-impacted stands of tropical wet evergreen forest in Arunachal Pradesh, Eastern Himalayas, India. *Biodiv. Conserv.* 2003, 12, pp. 1753-1773.
- [7] Demel, Teketey Seedling population and regeneration of woody species in dry Afromontane forest of Ethiopia. *For. Ecol. Manage.* 1997a, 98, pp. 149-165.
- [8] Demel, Teketey, The impact of clearing and conversion of dry Afromontane forest in to arable land on the composition and density of soil seed banks. *Acta Ecol.* 1997b, 18, pp. 557-573.
- [9] Demel, Teketey, Granstrom, A. Soil seed banks in dry Afromontane forests of Ethiopia. *J. Veg. Sci.* 1995, 6, pp. 777-786.
- [10] Denslow, S. Tropical tree fall gaps. *Ann. Rev. Ecol. Syst.* 1987, 17, pp. 430-441.
- [11] Enright, N.J. and Watson, A.D. A matrix model analysis for the tropical tree *Araucaria cunninghamii*. *Aust. J. Ecol.* 1991, 16, pp. 507-520.
- [12] Feyera, Senbeta. Biodiversity and ecology of Afromontane rain forests with wild Coffee arabica L. Populations in Ethiopia. *Ecology and Development Series.* Cuvillier Verlag, Gottingen, 2006, 38, pp. 1-152.
- [13] Foster, R.B. Heterogeneity and disturbance in tropical vegetation. In: Soule, M E and Wilcox, B A (Eds.), *Conservation Biology.* Sinauer, Sunderland, M A USA, 1980, pp. 75-92.
- [14] Garwood, C. Tropical soil seed banks: a review. In: Leck, M; Simpson, R and Parker, V (Eds.), *Ecology of soil seed banks.* Academic Press San Diego, 1989, pp 149-209.
- [15] Getachew, Tesfaye, Demel, Tiketay and Masresha, Fetene, Regeneration of fourteen tree species in Harena forest, southeastern Ethiopia, *Flora.* 2002, 197, pp. 461-467.
- [16] Grubb, P.J. The maintenance of species richness in plant communities. The importance of the regeneration niche. *Biol. Rev.*, 1977, 52, pp. 107-145.
- [17] Harper, J.L. *Population biology of plants.* Academic Press London. 1977.
- [18] Hubble, P. and Foster, B. Biology, chance and history and the structure of tropical rain forest communities. In: Diamond, J. Case. J. (Eds), *Community Ecology.* Harper and Row, New York, 1986, pp 314-329.
- [19] Khan, M.L., Rai, J.P.N., Tripathi, R.S. Population structure of some tree species in disturbed and protected sub-tropical forests of north-east India. *Acta Oecologia: Oecologia Applicata (France)*, 1987, 8: 247-255.
- [20] Kumar, Munesh, Sharma, C.M., Rajwar, G.S. and Mishra, A. Community structure and plant biodiversity in relation to disturbance gradient in temperate forest of Garhwal Himalaya. *Van Vigyan.* 2001,39(1-4): pp.1-9.
- [21] Kumar, Munesh, and Bhatt, V.P. Plant biodiversity and conservation of forests in foot hills of Garhwal Himalaya. *Journal of Ecology and Application*, 2006,11(2): pp. 43-59.
- [22] Lykke, A.M. Assessment of species composition change in savanna vegetation by means of woody plants size class distributions and local information. *Biodiv. Conserv.* 1993,7, pp.1261-1275.
- [23] Odum, E.P. *Fundamentals of Ecology.* III ed. W.B. Saunders Co., Philadelphia. USA. 1971.

- [24] Pangtey, Y.P.S., Samant, S.S., Bankoti, N.S. and Rawal, R.S. Soil and Vegetation Analysis of Pindari Area. Second Annual Report submitted to Department of Environment, New Delhi, 1989, pp.167.
- [25] Rao, P., Barik, S.K., Pandey, H.N., and Tripathi, R.S. Community composition and tree population structure in a subtropical broad-leaved forest along a disturbance gradient. *Vegetatio*. 1990, 88. pp. 151-162.
- [26] Saxena, A.K., Singh, J.S. Tree population structure of certain Himalayan forest associations and implications concerning their future composition. *Vegetatio*. 1984, 58: pp. 61-69.
- [27] Saxena, A.K., Singh, S.P. and Singh, J.S. Population Kumaon Himalaya. Implications for management. *J. Environ. Manage.* 1984, 19. pp. 307-324.
- [28] Silvertown, J. Introduction to plant population ecology, Longman, New York. 1982.
- [29] Swaine, M.D. Ecology of tropical tree seedlings. Parthenon Publishing, UNESCO, Peris. 1996.
- [30] Tripathi, R.S. and Khan, M.L. Regeneration dynamics of natural forests – A review. *Proc. Indian Natl. Sci. Acad.* 2007, 73, pp.167– 195.
- [31] Vablen, T.T., Ashton, D.H. and Schlsel, F.J. Tree regeneration strategies in lowland Nothofagus dominated forest in south-central Chile. *J. Biogeogr.*, 1979, 6, pp.329–340.
- [32] Whitmore, T. A review of some aspects of tropical rain forest seedling ecology with suggestion for further enquiry. In Swaine, M (Eds.), *The ecology of tropical forest tree seedlings*. Parthenon Publishing, Peris, 1996, pp 3-9.

AUTHORS

First Author – J P Mehta, Department of Botany, HNB Garhwal University Srinagar Garhwal, India, E mail: jagatpmehta@gmail.com
Second Author – Shreshthamani, Department of Botany, HNB Garhwal University Srinagar Garhwal, India
Third Author – V P Bhatt, Department of Botany, Govt P G College Gopeshwar, Chamoli, India, E mail: bhattvp3@yahoo.com

Water Quality Assessment of River Ganga Health Hazard Identification and Control

Singh Rajesh¹, Bahukhandi Kanchan², Mondal Prasanjeet³ Singh Satendra⁴

¹ National Institute of Hydrology, Roorkee, Uttarakhand, India

² University of Petroleum and Energy Studies, Dehradun, Uttarakhand, India

³ University of Petroleum and Energy Studies, Dehradun, Uttarakhand, India

⁴ University of Petroleum and Energy Studies, Dehradun, Uttarakhand, India

Abstract- The present project 'Water Quality Assessment of river Ganga Health Hazard Identification and control' includes tests for, pH value, Electrical Conductivity, Total Dissolve Solid, Hardness, Alkalinity, Chloride, Nitrate, Sulphate, Iron, Sodium, Potassium, Calcium and Magnesium. Result was compared with drinking water standard prescribed by BIS 10500-2012 and all parameters satisfied the prescribed limit given in BIS standard for drinking water. Water Quality of river Ganga from Gangotri to Haridwar is found Pollution free. Spatial variation in river water quality is shown by Quality Contour Map by using Surfer Software 9.0 version. Maximum water quality deviation from mean value is observed at Haridwar which shows the adverse impact of Industrialization, Urbanisation and Rapid growth of population on the river water quality.

Index Terms- water quality, IS: 10500, Electrical Conductivity, Total Dissolve Solid, Hardness, Alkalinity, Chloride, Nitrate, Sulphate, Iron, Sodium, Potassium, Calcium, Magnesium, Surfer 9.0.

I. INTRODUCTION

The River Ganga is a perennial river originating from the Himalayas and flowing through many states before its confluence with Bay of Bengal. The Ganga basin accounts for a little more than one-fourth (26.3%) of the country's total geographical area and is the biggest river basin in India. Ganga plain is one of the most densely populated regions of the world, due to its availability of water, fertile soil and suitable landscapes.

The Ganga has been worshipped by Indians from time immemorial and the practice still continues. The water of the Ganga was considered to be holy, having powers to rid us from all our sins it is also used for various purposes such as drinking, bathing, power generation, recreation, community water supply, irrigation etc. This water is being polluted by indiscriminate disposal of sewage, industrial waste and human activities which affect quality of river water. The increased anthropogenic

activities (Praveen et al. 2012) large scale deforestation and over grazing in the watershed areas of river basins is having adverse impact on river water quality and is affecting the flora and fauna (Joshi et al. 2009). It is a fact that good water quality produces healthier humans. Freshwater scarcity ranks among the most urgent environmental challenges of this century. To water resources management and pollution mitigation plan it is essential to have relevant information on water quality status and trend to describe overall water quality conditions. Therefore it is necessary to monitor and assess the water quality of River Ganga.

It is of utmost importance that the River Ganga be restored to its past glory. It is an urgent need to improve its water quality; this can be achieved by regular monitoring and assessment of water quality. A conscious effort towards reversing the current trends of deterioration of water quality of Ganga is the need of the hour. However, the ability to properly track progress toward minimizing impacts on natural environments and improving access of humans to safe water depends on the availability of data that document trends. As such assessing of water quality of River Ganga is a necessary activity at all governing levels: local, national. Keeping these facts in mind current study focused on assessments including approaches to their identification, analysis and resolution of current water quality status and trends of river Ganga from Gangotri to Haridwar.

II. MATERIAL AND METHODS

A total number of 23 samples were collected of river Ganga from approximate length of 254 Km starting from Gangotri to Bishanpur (Haridwar) and analysed. The samples were collected during winter period with their GPS coordinates during December 2014 and preserved by adding an appropriate reagent (Jain and Bhatia, 1988; APHA, 1992) Full care has been taken to ensure obtaining a sample that is truly representative. Further, the integrity of the sample was maintained from the time of collection to the time of analysis. Descriptions of River water sampling location along with their GPS coordinates are given in

Table 2.1 and these location are also shown in satellite map fig 2.1

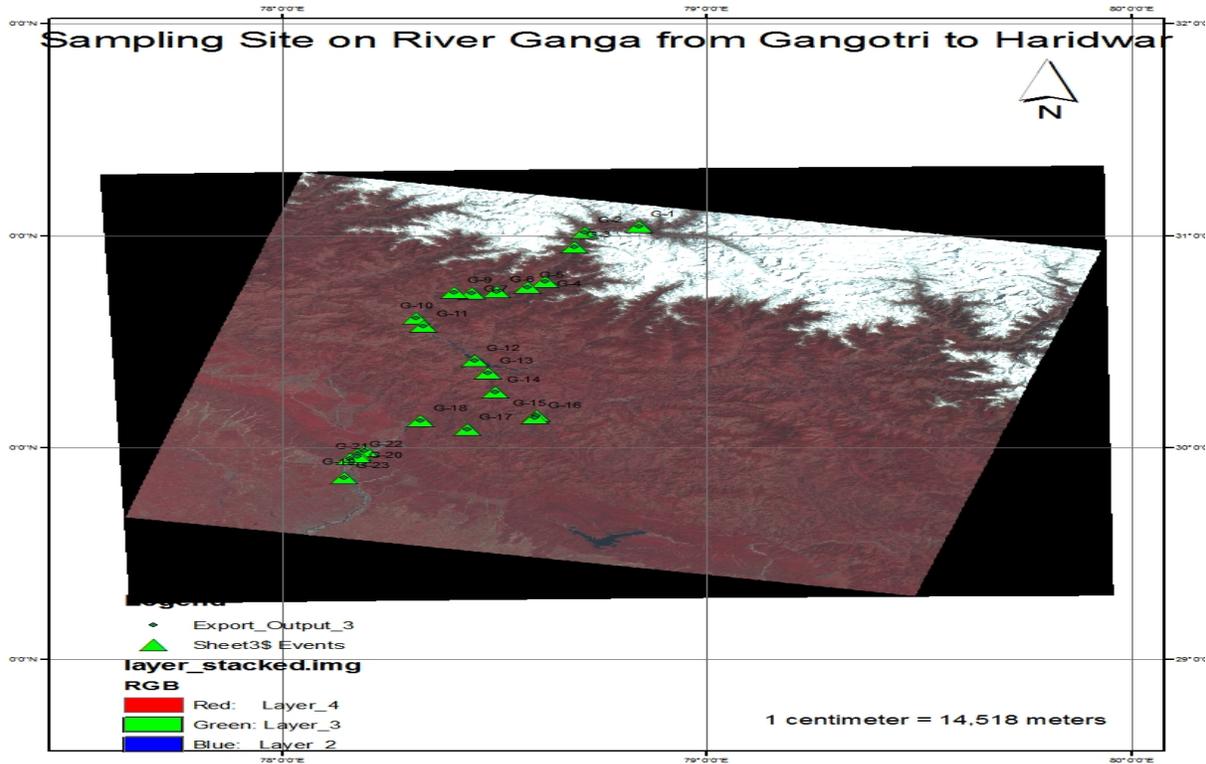


Fig 2.1 Sampling site on satellite map of river Ganga

Table-2.1 Sampling Sites-

Code	Location	Long.	Lat.	Hight (m)	Distance(Km)
G-1	Jangla Bridge	78.84065833	31.0433278	2585	0
G-2	Jhala Bridge	78.71349861	31.0159611	2378	26.490613
G-3	Dabrani Bridge	78.68833889	30.9462333	1966	34.699657
G-4	UK Laghu Vidhut Pariyojna	78.61881389	30.7853278	1430	54.332124
G-5	Nalluna Senj	78.578	30.756875	1320	54.332124
G-6	After Heena Power Station	78.50666667	30.7362603	1208	66.772303
G-7	u/s Uttarkashi	78.44674722	30.7295	1076	75.606229
G-8	d/s Uttarkashi	78.43944444	30.7258333	1106	76.264219
G-9	Badethi Chungi	78.43944444	30.7303528	1053	79.404703
G-10	Dharashu	78.31622222	30.6106639	815	99.205983
G-11	Chinyalisaur	78.332475	30.5745333	790	103.34455
G-12	Tehri Reservoir (Koti colony)	78.45367778	30.4123139	792	125.445578
G-13	Zero Bridge Tehri	78.48515	30.3527278	561.95	133.415968
G-14	Downstream of Koteswar PP	78.50085556	30.2625472	518	144.180048
G-15	Bhagirathi Devprayag	78.59858611	30.1510139	462	160.430282
G-16	Ganga Devprayag	78.59638611	30.1407139	365.48	161.979644
G-17	Lakundi Shiv Chula	78.435275	30.0858028	321	187.707604
G-18	Lakhman Chula Rishikesh	78.32709167	30.126375	312	205.295911

G-19	Saptrishi Ashram	78.19606389	29.9871056	243.308	226.962528
G-20	Bhimgowada Barrage	78.17639444	29.9698833	242.42	229.997382
G-21	Khadkhadi	78.16209167	29.947425	236.59	232.421654
G-22	Gujrawala Bhawan	78.17800833	29.9573194	234	242.092785
G-23	Bisanpur village	78.14702222	29.8577361	217.5	254.712282

Software Arc GIS 9.3 and Surfer 9 are used for Showing the study area and sampling location and plotting the Water Quality Parameter status graph and their trend respectively. Water sample analysis was performed as per standard method (Jain and Bhatia, 1988; APHA, 1992) at National Institute of Hydrology, Roorkee laboratory (An ISO 9001-2008 Certified)

The details of analytical method and equipment used in the study are described in Table 6. Ionic balance was calculated, the error in the ionic balance for majority of the samples was within 5%. The total number of selected parameters is thirteen for assessing water quality of river Ganga.

Table 2.2 Details of the analytical method and equipment used in the study

Parameter	Method	Instrumentation and Apparatus
pH	Electrometric	pH Meter
Conductivity	Electrometric	Conductivity Meter
TDS	Electrometric	Conductivity Meter/TDS Meter
Alkalinity	Titration by H ₂ SO ₄	-
Hardness	Titration by EDTA	-
Chloride	Titration by AgNO ₃	-
Sulphate	Turbidimetric	Turbidity Meter
Nitrate	Ultraviolet Screening	UV-VIS Spectrophotometer
Sodium	Flame Emission	Flame Photometer
Potassium	Flame Emission	Flame Photometer
Calcium	Titration by EDTA	-
Magnesium	Titration by EDTA	-
Iron	Spectrophotometric	Spectrophotometer

III. ANALYSES AND INTERPRETATION OF DATA

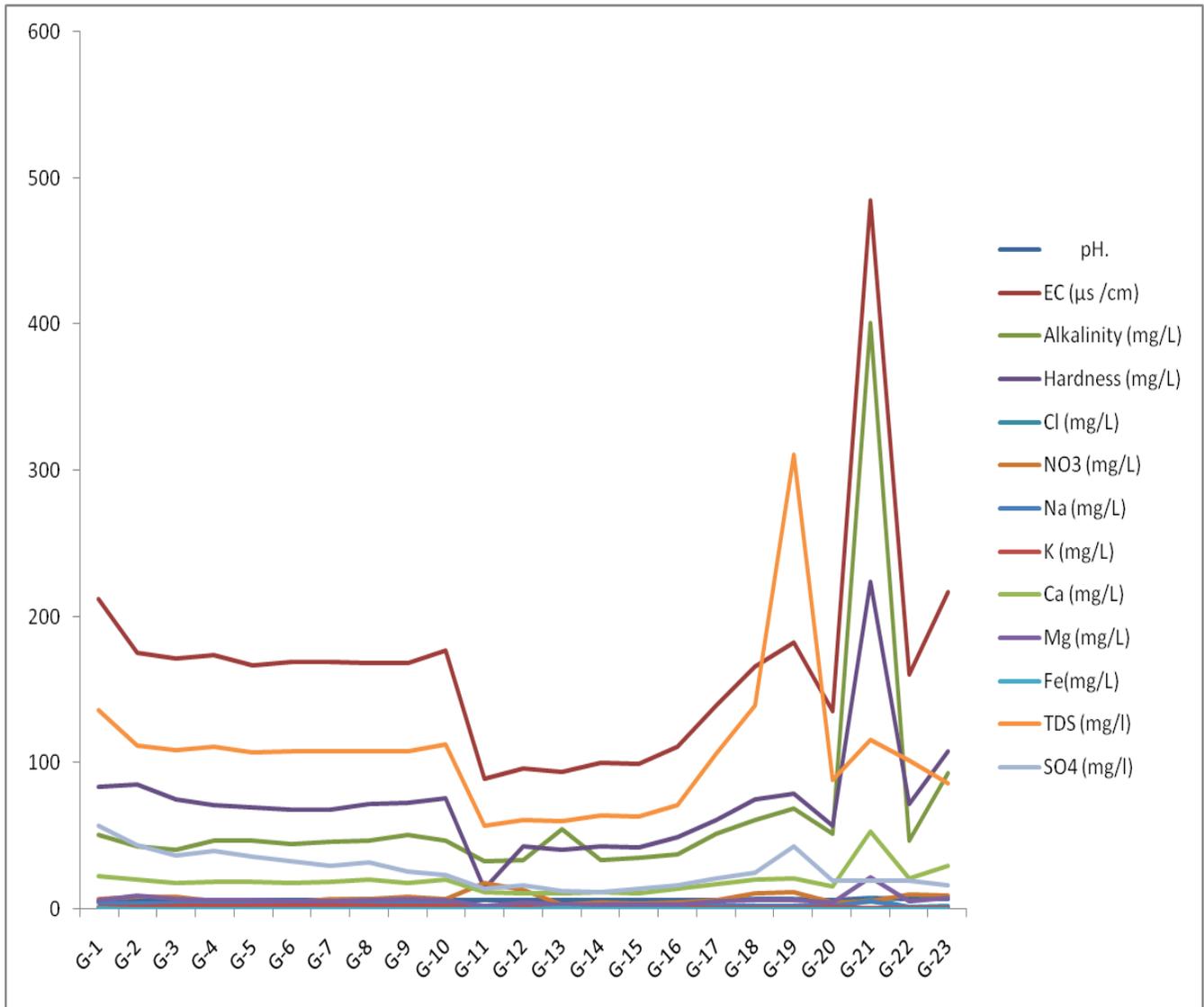
The samples were analyzed for assessment of water quality as per standard methods (APHA, 1999). The parameters such as pH, Conductivity, TDS, Alkalinity, Hardness, Chloride, Sulphate, Nitrate, Sodium, Potassium, Calcium, Magnesium, and Iron for samples from River Ganga were analyzed and the results are given in Table 3.1. Water quality status of River Ganga from Gangotri to Haridwar in terms of selected 13 parameters is found within specified limit as prescribed by BIS 2012 (Table 3.2). A close examination clearly indicates that all parameter are complying with the standards (BIS 10500). However the Quality of Water is spatially varying in nature from Gangotri to Haridwar. But it can be concluded that River Ganga in Uttarakhand is relatively clean and complying with the criteria. It has been observed that at Bisanpur and Khadkhadi, deviation from mean values is more for maximum nos of parameter. After deep analysis of all possible causes it is found that the discharge from Jagjeet-Pur, Sewage treatment plant is the most probable cause of the deviation. Jagjeet-pur STP, received entire sewerage of haridwar city which is nearly 55-60 MLD but installed treatment capacity is only 45 MLD. Remaining (60-45=15) MLD sewage water directly being discharged into the river Ganga. Results of all parameters at all the location are shown in table 3.2

Table-3.1 Compliance of River Water Quality with BIS Standard

Parameters	Acceptable Limit	Allowable Limit	Water Quality of River Ganga
pH	6.5-8.5	No Relaxation	Within Limit
Conductivity	-	1,500 $\mu\text{s/cm}$ (WHO)	Within Limit
TDS	500	2000	Within Limit
Alkalinity	200	600	Within Limit
Hardness	200	600	Within Limit
Chloride	250	1000	Within Limit
Sulphate	200	400	Within Limit
Nitrate	45	No Relaxation	Within Limit
Sodium	200 (WHO)	-	Within Limit
Potassium	10 (WHO)	-	Within Limit
Calcium	75	200	Within Limit
Magnesium	30	100	Within Limit
Iron	0.3	No Relaxation	Within Limit

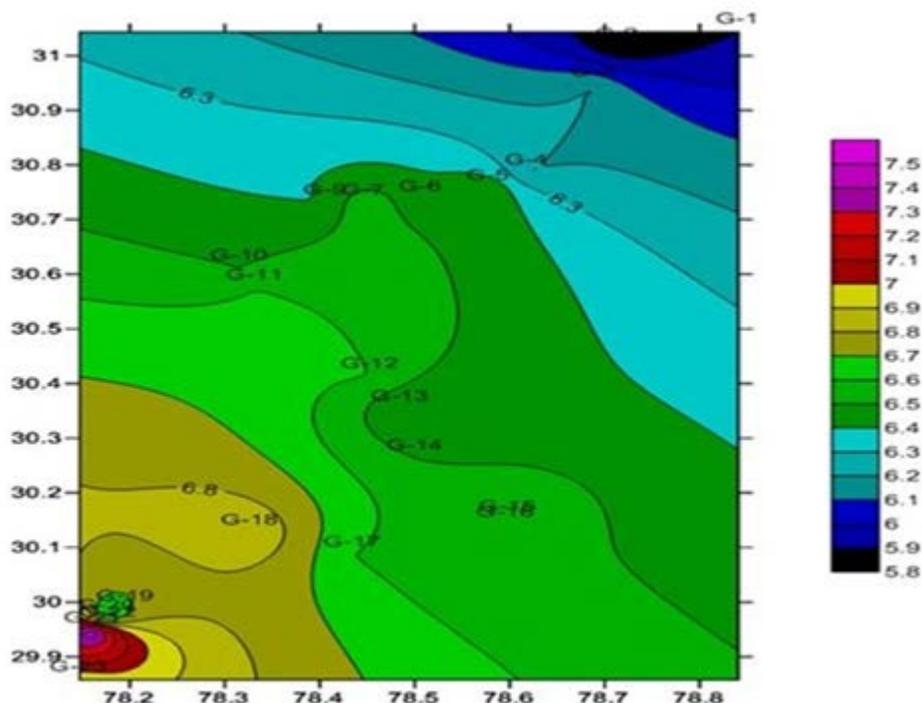
Table 3.2 Physico-chemical characterization of River Ganga Samples

Sample Code	Location	pH.	EC (µs/cm)	Alkalinity (mg/L)	Hardness (mg/L)	Cl (mg/L)	NO3 (mg/L)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	TDS (mg/l)	SO4 (mg/l)
G-1	Jangla Bridge	5.9	212	51	84	0.2	7	4.4	1.6	23	6	0.5	136	57
G-2	Jhala Bridge	5.8	175	43	85	4.2	8.8	3.9	1.6	20	9	0.17	112	44
G-3	Dabrani Bridge	6.2	171	41	75	0.8	8.4	3.9	1.7	18	7	0.16	109	37
G-4	UK Laghu Vidhut Pariyojna	6.2	174	47	71	0.8	5.3	5.1	1.9	19	6	0.21	111	40
G-5	Nalluna Senj	6.5	167	47	70	1.4	1.3	4.8	1.9	19	6	0.06	107	36
G-6	After Heena Power Station	6.4	169	45	68	0.4	4.8	5.1	1.9	18	5	0.08	108	33
G-7	u/s Uttarkashi	6.6	169	46	68	2.2	6.6	4.8	2	19	5	0.07	108	30
G-8	d/s Uttarkashi	6.7	168	47	72	1.8	6.6	4.7	2	20	6	0.06	108	32
G-9	Badethi Chungi	6.4	168	51	73	1.2	8.8	4.3	1.8	18	7	0.07	108	26
G-10	Dharashu	6.5	177	47	76	2	7	4.5	1.7	20	6	0.09	113	24
G-11	Chinyalisaur	6.6	89	33	14	0.2	18	1.7	1.1	12	2	0.15	57	14
G-12	Tehri Reservoir (Koti colony)	6.6	96	34	43	0	13	1.7	1.3	11	4	0.18	61	17
G-13	Zero Bridge Tehri	6.4	94	55	41	1.2	3.1	1.8	1.1	11	3	0.27	60	13
G-14	Downstream of Koteswar PP	6.5	100	34	43	1.4		1.7	1.1	12	3	0.06	64	12
G-15	Bhagirathi Devprayag	6.6	99	35	42	0.4	4	1.6	1	11	3	0.08	63	14
G-16	Ganga Devprayag	6.5	111	38	49	1.2	4.8	2	1	14	3	0.1	71	17
G-17	Lakundi Shiv Chula	6.6	139	52	61	2.4	5.7	1.6	0.8	17	5	0.1	106	21
G-18	Lakhman Chula Rishikesh	6.9	166	61	75	2.4	11	1.7	0.8	20	6	0.07	139	25
G-19	Saptrishi Ashram	6.7	182	69	79	2.4	12	1.6	0.7	21	6	0.19	311	43
G-20	Bhimgowada Barrage	6.5	135	52	57	0	4.8	1.7	0.9	16	4	0.1	88	20
G-21	Khadkhadi	7.5	485	401	224	7.4	5.3	5	0.5	53	22	0.02	116	20
G-22	Gujrawala Bhawan	7	160	47	72	2	9.7	1.2	0.7	21	5	0.08	102	20
G-23	Bisanpur village	6.9	217	93	108	2.2	9.2	1.4	0.5	30	8	0.02	86	17



pH- As it is clear from the above graph that pH Values at the entire length of river are within specified limit (The pH of most natural waters ranges between 6.5 and 8.5). However it has been observed (see graph) that pH values at Jangla Bridge, Jhala Bridge, Debrani Bridge, UK Laghuvidut pariyojna and at Naluna

Senj are less than 6.5 due to dissolution of carbon dioxide and low alkalinity. On the other hand pH at Khadkhadi is maximum (but within the limit).For better understanding of spatial variation in pH concentration pH contour map is given here-



Explanation-It is clearly shown in contour map that pH Values is increasing as we moves downstream from Gangotri. Highest pH is shown near Haridwar.

Electrical Conductivity- Electrical Conductivity is within limit in entire course of river however its values are spatially varies .Electrical conductivity at Khadkhadi is found maximum but within limit. However from Chinyalisur to Lakhundi Shiv-Chula electrical conductivity are observed below mean values. But overall Electrical Conductivity is within limit and showing good health of River. Conductivity is within limit and showing good health of river.

Alkalinity- Alkalinity has crossed the Acceptable limit at Khadkhadi (401 mg/l), otherwise concentration of alkalinity in entire length of river is almost uniform and within the permissible limit.

Hardness- Hardness values are found to be within specified limit along the entire length of River Ganga (from Gangotri to Haridwar) highest alkalinity is observed at Khadkhadi (224mg/l) and minimum at Chinyalisaur.

Chloride- Chloride content in River Ganga is found within prescribed limit, which shows that river is healthy. Maximum chloride concentration is found at Khadkhadi (7.4mg/l) and minimum at Tehri Reservoir.

Nitrate- Nitrate concentration in river Ganga is found within desired limit which indicate that river is pollution free. Maximum Nitrate is observed at Chinyalisaur and minimum at Nalluna-Senj.

Calcium- Calcium concentration in River Ganga water is observed within limit and no health hazard is observed. River is healthy and pollution free. Maximum concentration is observed at Khadkhadi (53mg/l) and minimum at Tehri.

Iron- Concentration of iron is found within desirable limit in entire length of river from Gangotri to Haridwar except at Jangla Bridge (Due to watershed rock characteristics). The maximum concentration is observed at Jangla Bridge and Minimum at

Bisanpur village and Khadkhadi but overall concentration of iron is found within desired limit which indicate healthy river condition.

Magnesium- Magnesium concentration found maximum at Khadkhadi and minimum at Chinyalisur but both limit are within prescribed limit which indicated that river is pollution free and there is no health hazards. Concentration of magnesium is varying from site to site. Variation does not follow any specific trend, it is unsymmetrical in nature.

Sodium- The sodium concentration in river Ganga from Gangotri to Haridwar is found within limit. The maximum concentration of Sodium is observed at UK Laghuvidhut pariyojana site and at Naluna -Senj at Khadkhadi the concentration of Sodium is observed 5.0 mg/l .But as a conclusion it can be say that river is pollution free and Healthy in terms of Sodium.

Potassium- Concentration of potassium is found within prescribed limit. Which shows that river is pollution free from Gangotri to Haridwar and there is no Health hazard. The maximum concentration is observed at Upstream of Uttarkashi and minimum at Khadkhadi and Bisanpur village.

Sulphate- Sulphate in River Ganga is found within limit and hence river is free from sulphate pollution from Gangotri to Haridwar and there is no health hazard due to excessive sulphate. However Sulphate concentration is not uniform in entire length of river, maximum sulphate concentration is observed at Gangotri (54mg/L) and minimum at Alaknanda (12mg/l).

Total Dissolved Solid- TDS in river Ganga (from Gangotri to Haridwar) is found within prescribed limit. Its values vary from location to location .Maximum TDS is observed at Saptarishi Aashram (311mg/l) and minimum at upstream of Uttarkashi (57mg/l). But overall water quality is good in river Ganga.

IV. CONCLUSIONS /SUGGESTION /FINDING

Overall water Quality of River Ganga from Gangotri to Haridwar is found Healthy and Pollution free. However, most of the parameters were in increasing as the river travels. Maximum concentration for most of the parameter was observed at Khadkhadi (Haridwar) which is an indication of impact of pollution due to anthropogenic activities. Drains which directly or indirectly discharging into the river, without proper treatment is found to be major source of pollution. Policy should to be framed for proper treatment of the drains before reaching river Ganga, so that water quality could be maintained. Co-ordination integration, participatory approach among various agencies, departments and groups should to be essential part of Ganga Rejuvenation Scheme.

REFERENCES

- [1] Bahukhandi Kanchan Deoli and Bartarya S.K,(2014), major ion chemistry of asanrivercatchment of dehradun district (impact assessment of anthropogenic sources),Octa Journal of Environmental Research, 2014,Vol. 2(2): 168-177.
- [2] Bharti N and Katyal.D,(2011), Water quality indices used for surface water vulnerability assessment, international journal of environmental sciences volume 2, no 1, 2011
- [3] C.K. Jain,(2002), A hydro-chemical study of a mountainous watershed-the Ganga, National Institute of Hydrology, Environmental Hydrology Division, JalVigyanBhawan, Roorkee 247 667, India .Water Research 36 (2002) 1262–1274
- [4] Dhananjay Kumar, Anjali Verma, NamitaDhusia and Nandkishor More,(2013), Water Quality Assessment of River Gomti in Lucknow , Volume 3, Issue 3: 337-344.
- [5] Gadekar M.R.,GonteR.N,Paithankar V.K, Sangale Y.B and Yeola N.P.(2012),River water Quality degisnation, International Journal of

Emerging Technology and Advanced Engineering (ISSN 2250-2459, Volume 2, Issue 9, September 2012)

- [6] Lenntech Water Treatment Sollution.(<http://www.lenntech.com>)
- [7] Nighojkar Abhineet and ER. D.Dohare,(2014), Physico-Chemical Parameters for Testing of Present Water Quality of KhanRiver at Indore, International Research Journal of Environment Sciences Vol. 3(4), 74-81, April (2014)
- [8] Pankaj Kumar Roy, Deeya Ray, Somnath Pal, Gourab Banerjee, ArunabhaMajumder and AsisMazumdar,(2014), Qualitative and Quantitative Assessment of Pollutational Load in River Ganga in West Bengal Using Statistical Technique, World Applied Sciences Journal 29 (5): 634-640, 2014
- [9] Richa Seth , Manindra Mohan , Prashant Singh ,Rakesh Singh , RajendraDobhal ,Krishna Pal Singh , Sanjay Gupta,(2014), Water quality evaluation of Himalayan Rivers of Kumaunregion,Uttarakhand, Appl Water Sci DOI 10.1007/s13201-014-0213-7
- [10] R.M.Bhardwaj (2005), Water quality monitoring in india- Achievements and constraints,Central Pollution Control Board, IWG-Env, International Work Session on Water Statistics, Vienna, June 20-22 2005.
- [11] Report of CPCB on Pollution trend of river Ganga 2013

AUTHORS

First Author – Singh Rajesh, National Institute of Hydrology, Roorkee, Uttarakhand, India

Second Author – Bahukhandi Kanchan, University of Petroleum and Energy Studies, Dehradun, Uttarakhand, India

Third Author – Mondal Prasanjeet, University of Petroleum and Energy Studies, Dehradun, Uttarakhand, India

Fourth Author – Singh Satendra, University of Petroleum and Energy Studies, Dehradun, Uttarakhand, India

Awareness and Consequences of Human Immuno Deficiency Virus Disease among Undergraduate Students of University of Ilorin

¹Onifade, O. A. (Ph.D.), ² Ruth Adio-Moses (Ph.D.), ¹Ologele, I. (Ph.D.), ¹Adigun, J. O. (M.Ed.), ¹Ogungboye, R. O. (M.Ed.), ¹Abikoye, A. I. (M.Ed.) and ¹Oguntunji, I. O. (M.Ed.)

¹Department of Health Promotion and Environmental Health Education, Faculty of Education, University of Ilorin, Nigeria.

²Department of Human Kinetics and Health Education, University Of Ibadan

Abstract- The study examined awareness and consequences of human immune deficiency virus disease among undergraduate students of University of Ilorin. Four research hypotheses were postulated and tested at 0.05 alpha level. The research design adopted for the study was survey type. Through simple random technique, five (5) departments were selected and a sampled size of four hundred and twenty was drawn from selected departments with the use of stratified sampling technique in the University of Ilorin, Kwara State. Data were collected with the use of researcher's structured questionnaire already validated by the three experts in the field of Human Sexuality, Health Education and Sociology and tested with the use of test re-test reliability technique. A reliability coefficient of .75r was obtained. Demographic data collected were analyzed with the aid of frequency count and simple percentage while the postulated hypotheses were tested with the use of inferential statistics of Chi-square. The result of the study revealed that undergraduate students are significantly different in their awareness on causes, transmission routes, consequences and control of HIV/AIDS. Based on these findings, the researcher recommended that undergraduate students should abstain from indiscriminate sex, it is also recommended that HIV/AIDS education should be carried out by professional concerned in the universities.

Index Terms- HIV/AIDS, causes, transmission routes, indiscriminate sex, HIV/AIDS education

I. INTRODUCTION

Human immunodeficiency virus (HIV) is a [lentivirus](#) (slowly replicating [retrovirus](#)) that causes [acquired immunodeficiency syndrome](#) (AIDS), a condition in humans in which progressive failure of the [immune system](#) allows life-threatening [opportunistic infections](#) and [cancers](#) to thrive. Infection with HIV occurs by the transfer of [blood](#), [semen](#), [vaginal fluid](#), [pre-ejaculate](#), or [breast milk](#). Within these bodily fluids, HIV is present as both free virus particles and virus within infected [immune cells](#) (Douek, Roederer and Koup, 2009).

According to Chitnis, Rawls and Moore (2000), HIV infects vital cells in the human immune system such as [helper T cells](#) (specifically $CD4^+$ T cells), [macrophages](#) and [dendritic cells](#). HIV infection leads to low levels of $CD4^+$ T cells through a number of mechanisms including: [apoptosis](#) of uninfected bystander cells, direct viral killing of infected cells, and killing of

infected $CD4^+$ T cells by [CD8 cytotoxic lymphocytes](#) that recognize infected cells. When $CD4^+$ T cell numbers decline below a critical level, [cell-mediated immunity](#) is lost, and the body becomes progressively more susceptible to opportunistic infections.

Two types of HIV have been characterized as- HIV-1 and HIV-2. HIV-1 is the virus that was initially discovered and termed both LAV and HTLV-III. It is more [virulent](#), more [infective](#) (Gilbert, McKeague, Eisen, Mullins, Guéye-Ndiaye, Mboup and Kanki, 2003) and is the cause of the majority of HIV infections globally. The lower infectivity of HIV-2 compared to HIV-1 implies that fewer of those exposed to HIV-2 will be infected per exposure. Because of its relatively poor capacity for transmission, HIV-2 is largely confined to [West Africa](#) (Reeves and Doms, 2002).

A 2008 study in Botswana, Namibia and Swaziland found that these disadvantages have an additive effect on HIV status. The authors found that four factors (intimate partner violence, extreme poverty, education and partner income disparity) explained almost all of the difference in HIV status between adults aged 15–29 years. Among young women with any one of these factors, the HIV rate increased from 7.7 percent with no factors to 17.1 percent. Some 26 percent of young women with any two factors were HIV positive; 36 percent of those with any three factors and 39.3 percent of those with all four factors were HIV-positive (Poku and Whiteside, 2004).

The West Africa region has generally moderate levels of infection of both [HIV-1 and HIV-2](#). The onset of the HIV epidemic in West Africa began in 1985 with reported cases in Côte d'Ivoire, Benin and Mali. Nigeria, Burkina Faso, Ghana, Cameroon, Senegal and Liberia followed in 1986. Sierra Leone, Togo and Niger in 1987; The Gambia, Guinea-Bissau and Guinea in 1989; and finally Cape Verde in 1990 (Andersson and Cockcroft, 2012).

United Nations Population Fund (UNFPA) (2013) asserted that, in the world three million people died of AIDS-related diseases in 2005, more than 40 million people are living with HIV and each day 14,000 people half of them aged 15 to 24 are infected. At the end of 2007 an estimated 2.6 millions Nigerians were infected with HIV. The HIV prevalence rate among adults aged 15 and 49 was 3.1 percent of those aged 15-24 years were HIV positive (UNAIDS/WHO, 2008).

In Nigeria, an estimated 3.6 percent of the population is living with HIV and AIDS (UNGASS, 2010). Although, HIV prevalence is much lower in Nigeria than in other African

countries such as South Africa and Zambia, the size of Nigeria's population (around 162.5 million) means that by the end of 2009, there were an estimated 3.3 million people living with HIV (UNAIDS, 2010). Approximately 220,000 people died from AIDS in Nigeria in 2009 (UNAIDS, 2010) with AIDS claiming so many lives, Nigeria's life expectancy has declined significantly. In 2010, the overall life expectancy was only 52 years (UNDP, 2011).

The factors responsible or causes of HIV/AIDS could be described as; cultural factors-It has been argued that the practice of [female genital mutilation](#) has led to an increased incidence of AIDS in Africa, since intercourse with a circumcised female is conducive to an exchange of blood (Clements, Greenough and Shull, 2006). Political factors- major African political leaders have denied the link between HIV and AIDS, favoring alternate theories. The scientific community considers the evidence that HIV causes AIDS to be conclusive and rejects [AIDS-denialist](#) claims as pseudoscience based on conspiracy theories, faulty reasoning, cherry picking and misrepresentation of mainly outdated scientific data. Despite its lack of scientific acceptance, AIDS denialism has had a significant political impact, especially in South Africa under the former presidency of [Thabo Mbeki](#) (Mark, 2000).

Religious factors- Mark (2013) opined that pressure from both Christian and Muslim religious leaders has significantly impeded progress to a variety of safe-sex campaigns, including safe-sex commercials being banned in Kenya and catholic church's ban on condoms in 2009 as well as the renewed banning of condoms in catholic schools in 2013. Medical suspicion- there is low levels of medical suspicion throughout Africa and there is evidence that such distrust may have a significant impact on the use of medical services (Savelsberg, Ndonko and Schmidt-Ehry, 2000).

Economic factors-Lack of money is an obvious challenge, although a great deal of aid is distributed throughout developing countries with high HIV/AIDS rates. For African countries with advanced medical facilities, [patents](#) on many drugs have hindered the ability to make low cost alternatives (Susan and Hunter, 2003). Natural disasters and conflict are also major challenges, as the resulting economic problems people face can drive many young women and girls into patterns of sex work in order to ensure their livelihood or that of their family or else to obtain safe passage, food, shelter or other resources (Samuel, 2009).

Pharmaceutical industry-African countries are also still fighting against what they perceive as unfair practices in the international pharmaceutical industry (Meier, 2002). Medical experimentation occurs in Africa on many medications, but once approved, access to the drug is difficult. Drug companies must make a return on the money they invest on research and work to obtain patents on their intellectual capital investments which restrict generic alternatives production (Fox, 2010).

Three main HIV transmission routes include: heterosexual sex; approximately 80 percent of HIV infections in Nigeria are the result of heterosexual (Federal Republic of Nigeria, 2012). Factors contributing to this include a lack of information about sexual health and HIV, low levels of condom use and high levels of sexually transmitted diseases (STDs). Women are particularly

affected by HIV. In 2009, Women accounted for 56 percent of all adults aged 15 and above living with the virus (UNGASS, 2010). Blood transfusions- HIV transmission through unsafe blood account for the second largest source of HIV infection in Nigeria. Not all Nigerian hospitals have the technology to effectively screen blood and therefore, there is a risk of using contaminated blood. The Nigerian Federal Ministry of Health have responded by backing legislation on the requires hospitals to only use blood from the National Blood Transfusion Services which has far more advanced blood-screening technology (Egesie and Egesie, 2011).

Mother-to-child transmission- Each year around 75,000 babies in Nigeria are born with HIV (WHO/UNAIDS/UNICEF, 2011). It is estimated that 36,000 children are living with HIV in the country, most of which became infected from their mothers (UNAIDS, 2010). This has increased from 220,000 in 2007 (UNAIDS, 2008), most at risk groups in Nigeria include brothel and non-brothel based female sex workers, men have sex with men, injecting drug users, transport workers, members of the armed forces and police. It has been found that individuals that fall under these groups and their partners account for 40 percent of new HIV infected in Nigeria (Federal Republic of Nigeria, 2012).

Centre for Disease Control and Prevention (CDC) (2010) asserted that some people experience signs and symptoms of HIV as soon as they become infected while others do not. When they occur, early signs and symptoms are often mistaken for the flu or a mild viral infection. Therefore, the signs and symptoms are classified into two: early signs and symptoms include ; fever, headache, nausea, diarrhea, enlarge lymph nodes in the neck, armpits or groin, night sweat, skin rashes, joint pain, nasal congestion and mouth or genital ulcer.

Later signs and symptoms includes - rapid weight loss, dry cough, recurring fever or profuse night sweat, profound and unexplained fatigue, swollen lymph glands in the armpits groin or neck, diarrhea lasting more than a week, white spots or unusual blemishes on the tongue, in the mouth or in the throat, pneumonia, memory loss, depression and other neurological disorder (Mayor, 2012).

The consequences of HIV disease include; retrogression of finance, dermatological/skin diseases, such as Varicella Zoster Virus (VZY), an infection that causes chicken pox and shingles (herpes zoster), skin sores, brain inflammation; Herpes Simple Virus (HSV) and Kaposi's Sarcoma (KS) (Mark, 2000). Elizabeth (2014) opined that oral health problems like candidiasis, periodontal diseases, gingivitis; neurological problems like dementia, inability to think properly, brain tumor could be a result of HIV/AIDS. Mayor (2012) added weight loss, loss of muscle and fat, diarrhea and a slight fever as consequences of HIV disease.

HIV prevention can be achieved through pharmaceutical Strategies include- [microbicides for sexually transmitted diseases](#), [pre-exposure prophylaxis](#), [post-exposure prophylaxis](#), [HIV vaccines](#), [circumcision antiretroviral drugs](#) to reduce [viral load](#) in the infected and [condoms](#) (Larke, 2010). Some social strategies which people consider include the following : [sex education](#), [needle-exchange programmes](#), [safe injection sites](#), [safe sex](#), [serosorting](#), [sexual abstinence](#) and [immigration regulation](#) (Celum and Baeten, 2012)

Consistent condom use reduces the risk of heterosexual HIV transmission by approximately 80percent over the long-term (Crosby and Bounse, 2012). Where one partner of a couple is infected, consistent condom use results in rates of HIV infection for the uninfected person of below 1percent per year (WHO, 2003). Some data supports the equivalence of female condoms to latex condoms however the evidence is not definitive (Gallo, Kilbourne-Brook and Coffey, 2012). [Comprehensive sexual education](#) provided at school may decrease high risk behavior (Ljubojević and Lipozenčić, 2010) and the use of the [spermicide nonoxynol-9](#) may increase the risk of transmission due to the fact that it causes vaginal and rectal irritation (Baptista and Ramalho-Santos, 2009).

II. RESEARCH HYPOTHESES

1. Undergraduate students are not significantly different in their awareness of causes of HIV/AIDS.
2. Undergraduate students are not significantly different in their awareness of HIV/AIDS transmission routes.
3. Health problem is not a significant consequence of HIV/AIDS among undergraduate students.
4. Undergraduate students are not significantly different in their awareness of prevention and control of HIV/AIDS.

III. METHODOLOGY

This study was carried out with the use of descriptive survey method. The study population comprises of all undergraduates of

University of Ilorin, Kwara State. Five (5) departments were randomly selected for the study with the estimated population of two thousand and one hundred (2,100). Based on the population, a sample of four hundred and twenty (420) (representing 20 percent of the estimated population) was drawn with the use of stratified random sampling technique.

A self-structured questionnaire that had been thoroughly validated by experts in the field of Human Sexuality, Health Education and Sociology was instrument used for this study. A reliability coefficient of correlation of .75r was obtained through the use of test re-test method of reliability. Four research hypotheses were formulated and tested with the use of chi-square (X²) statistical method of analysis. The result of analysis and interpretation of data collected for the result were tabulated and explained below:

IV. RESULTS AND DISCUSSION

This dealt with the analysis of the raw data collected through the use of questionnaire administered to four hundred and twenty (420) selected respondents among undergraduates of University of Ilorin, Kwara State. The results of the analyses are tabulated below:

Hypothesis 1: Undergraduates students are not significantly different in their awareness of causes of HIV/AIDS.

Table 1: Chi-square analysis showing awareness of undergraduates students on causes of HIV/AIDS.

S/N	ITEM	SA	A	D	SD	Row total	Cal X ²	Df	Crit. Value	Rem.
1	Female genital mutilation may lead to transmission of HIV/AIDS	302 (71.9%)	105 (25%)	10 (2.4%)	3 (0.7%)	420	63.5	12	21.03	HO Rejected
2	Poor safe sex campaigns may result in HIV/AIDS	276 (65.7%)	139 (33.1%)	4 (1%)	1 (0.2%)	420				
3	Using of unsterilized medical instruments for different people increase the spread of HIV/AIDS	286 (68.1%)	105 (25%)	20 (4.8%)	9 (2.1%)	420				
4	Poor economy situation may result in sex work or prostitution thereby leading to spread of HIV/AIDS	299 (71.1%)	99 (23.6%)	18 (4.3%)	4 (1%)	420				
5	Inadequate medical facilities and personnel may increase the HIV/AIDS epidemic	300 (71.4%)	80 (19%)	21 (5%)	19 (4.5%)	420				
Column Total		1463	528	73	36	2100				

The findings from the analysis in the table 1 above shows that the calculated chi-square (X²) values was 63.5 while the table value was 21.03 at 0.05 alpha level of significance with degree of freedom (Df) 12. Since the calculated X² value of 63.5

was greater than the table values of 21.03, thus, the null hypothesis was rejected, which means that: undergraduates students are significantly different in their awareness on causes of HIV/AIDS.

Hypothesis 2: Undergraduates students are not significantly different in their awareness on transmission routes of HIV/AIDS.

Table 2: Chi-square analysis showing awareness of undergraduates students on transmission routes of HIV/AIDS.

S/N	ITEM	SA	A	D	SD	Row total	Cal X ²	Df	Crit. Value	Rem.
6	Lack of information about sexual health and HIV may lead to AIDS	306 (72.9%)	100 (23.8%)	10 (2.3%)	4 (1%)	420	179.1	12	21.03	HO Rejected
7	Low levels of condom use may result in HIV/AIDS	316 (75.2%)	86 (20.5%)	16 (3.8%)	2 (0.5%)	420				
8	Transfusion of unsafe blood causes HIV/AIDS	220 (52.4%)	160 (38.1%)	32 (7.6%)	8 (1.9%)	420				
9	HIV positive mother may infect her baby	280 (66.6%)	115 (27.4%)	20 (4.8%)	5 (1.2%)	420				
10	Brothel based female sex workers are at risk of contracting HIV/AIDS	205 (48.8%)	120 (30.5%)	51 (12.1%)	36 (8.6%)	420				
Column Total		1327	589	129	55	2100				

The findings from the analysis in table 2 above shows that the calculated chi-square(X²) value 179.1 against the table value of 21.03 at 0.05 alpha level of significance with degree of freedom (Df) 12. Since the calculated X² value of 179.1 was

greater than the table value of 21.03 thus, the null hypothesis was rejected, which means that: undergraduates students are significantly different in their awareness on transmission routes of HIV/AIDS.

Hypothesis 3: Health problem is not a significant consequence of HIV/AIDS.

Table 3: Chi-square analysis showing health problem as a consequence of HIV/AIDS.

S/N	ITEM	SA	A	D	SD	Row total	Cal X ²	Df	Crit. Value	Rem.
11	Running of stool may result from HIV/AIDS	323 (77%)	50 (12%)	40 (9.0%)	7 (2%)	420	171.6	12	21.03	HO Rejected
12	White patches in the mouth may be the outcome of being infected with HIV	215 (51.2%)	181 (32.9%)	21 (5%)	3 (0.7%)	420				
13	HIV positive people may experience chicken pox	267 (63.6%)	138 (32.9%)	10 (2.4%)	5 (1.1%)	420				
14	Selling of one's assets may end the life of HIV/AIDS patient	210 (50%)	155 (36.9%)	30 (7.1%)	25 (6%)	420				
15	HIV/AIDS patients may experience inability to think properly	217 (52%)	158 (38%)	25 (6.0%)	20 (4.0%)	420				
Column Total		1232	682	126	60	2100				

The findings from the analysis in the table 3 above shows that the calculated chi-square (X²) values was 171.6 while the table value was 21.03 at 0.05 alpha level of significance with degree of freedom (Df) 12. Since the calculated X² value of

171.6 was greater than the table values of 21.03, thus, the null hypothesis was rejected, which means that: Health problem is a significant consequence of HIV/AIDS.

Hypothesis 4: Undergraduates students are not significantly different in their awareness of prevention and control of HIV/AIDS.

Table 4: Chi-square analysis showing awareness of undergraduates students on prevention and control of HIV/AIDS.

S/N	ITEM	SA	A	D	SD	Row total	Cal X ²	Df	Crit. Value	Rem.
16	Sex education can prevents the spread of HIV/AIDS	296 (70.5%))	84 (20%))	30 (7.1%))	10 (2.4%))	420	168.5	12	21.03	HO Rejecte d
17	Using of new condom reduces HIV/AIDS epidemic	286 (68.1%))	119 (28.3%))	9 (21%))	6 (1.4%))	420				
18	Male circumcision reduces man's risk of acquiring HIV	198 (47.1%))	191 (45.5%))	21 (5%))	10 (2.4%))	420				
19	Immigration regulation reduces the chances of infected with HIV/AIDS	260 (62%))	115 (27.3%))	25 (5.9%))	20 (4.8%))	420				
20	Avoidance of indiscriminating sexual intercourse prevents the spread of HIV/AIDS	355 (84.5%))	45 (10.7%))	15 (3.6%))	5 (1.2%))	420				
Column Total		1395	554	100	51	2100				

The findings from the analysis in the table 4 above shows the calculated chi-square(X²) value of 168.5 against the table value of 21.03 at 0.05 alpha level of significance with degree of freedom (Df) 12. Since the calculated X² value of 168.5 was greater than the table value of 21.03 thus, the null hypothesis was rejected, which means that: undergraduates students are significantly different in their awareness on prevention and control of HIV/AIDS

V. DISCUSSION OF FINDINGS

The discussion of the findings is as follows:

The result obtained from the tested hypothesis one shows that undergraduate students were significantly different in their awareness on causes of HIV/AIDS. This was justified by the assertions of Clements, Greenough and Shull (2006) that female genital mutilation has led to an increased incidence of AIDS in Africa because intercourse with circumcised female is conducive to an exchange of blood. Mark (2013) opined that pressure from both Christian and Muslim religion leaders significantly impeded progress to several of safe-sex campaigns.

The result of the tested hypothesis two shows that undergraduate students were significantly different in their awareness on transmission routes of HIV/AIDS. The result was in accordance with the finding of Egesie and Egesie (2011) that HIV transmission through unsafe blood account for the second largest source of HIV information in Nigeria. The result was also affirmed by UNAIDS (2010) that each year around 75,000 babies in Nigeria are born with HIV and it is ascertained that 36,000 children are with HIV in the country most of which become infected from their mothers.

The result obtained from the tested hypothesis three shows that health problem was a significant consequence of HIV/AIDS. This is justified by the assertions of Mark (2006) that

dermatological diseases like chicken pox, brain inflammation could result from HIV disease and the entire asserts and savings of many families which are generally meager before the onset of the disease may be completely spent for the treatment. The finding also support the claim of Elizabeth (2014) who opined that oral health problems like candidiasis, periodontal diseases, gingivitis; neurological problems like dementia, inability to think properly, brain tumor could be a result of HIV/AIDS. Mayor (2012) equally added that weight loss, loss of muscle and fat, diarrhea and a slight fever could be the consequences of HIV disease.

The findings that undergraduate students were significantly different in their awareness on prevention and control of HIV/AIDS is in line with Croshy and Bounse (2012) that consistent condom use reduces the risk of heterosexual HIV transmission meanwhile Ljubojevic & Lipozenal (2010) affirmed that comprehensive sexual education provided at school may decrease high risk behavior of HIV/AIDS.

VI. CONCLUSION

Based on the findings from the analysis of the tested hypothesis, the following conclusions were drawn:

1. Undergraduate students were significantly different in their awareness on causes of HIV/AIDS. This implies that undergraduate students are aware of causes of HIV/AIDS.
2. Undergraduate students were significantly different in their awareness on transmission routes of HIV/AIDS. It implies that undergraduate students are aware of HIV/AIDS mode of transmission.
3. Health problem was a significant consequence of HIV/AIDS. It signifies that financial

breakdown and diseases like candidiasis, gingivitis and brain tumor may result from HIV/AIDS.

4. Undergraduate students were significantly different in their awareness on prevention and control of HIV/AIDS. It implies that undergraduate students are aware of preventive measures of HIV/AIDS.

VII. RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

1. Undergraduate students are advised to abstain from indiscriminate sex.
2. Students are advised to go for HIV test to know their status and to avoid its complication.
3. There is need for HIV/AIDS education to be carried out by professional concerned on causes and prevention of HIV/AIDS.

REFERENCES

[1] Andersson, N. & Cockcroft A. (2012). Choice disability and HIV status: evidence from a cross-sectional study in Botswana, Namibia and Swaziland. *AIDS and Behavior*.

[2] Baptista, M. & Ramalho-Santos, J. (2009). Spermicides, microbicides and antiviral agents: recent advances in the development of novel multi-functional compounds. *Mini reviews in medicinal chemistry* 9 (13): 1556–67. PMID 20205637.

[3] CDC. (2010). How can I tell if I am infected with HIV? What are the symptoms. Retrieved on May 7th, 2013. From <http://www.cdc.gov/hiv/resource/qa>

[4] Celum, C. & Baeten, J. M. (2012). Tenofovir-based pre-exposure prophylaxis for HIV prevention: evolving evidence. *Current opinion in infectious diseases* 25 (1): 51–7. PMC 3266126. PMID 22156901.

[5] Chitnis, A., Rawls, D. & Moore, J. (2000). Origin of HIV type 1 in colonial French equatorial Africa? *AIDS Research and Human Retroviruses* 16 (1): 5–8. PMID 10628811.

[6] Clements, C. J., Greenough, P. & Shull D. (2006) How vaccine safety can become political — the example of polio in Nigeria. *Current Drug Safety*.

[7] Crosby, R. & Bounse, S. (2012). Condom effectiveness: where are we now?. *Sexual health* 9 (1): 10–7. PMID 22348628.

[8] Douek, D. C., Roederer, M. & Koup, R. A. (2009). Emerging Concepts in the Immunopathogenesis of AIDS. *Annu. Rev. Med.* 60: 471–84.

[9] Egesie, J & Egesie, E. (2011). Seroprevalence of Human Immunodeficiency Virus (HIV) among blood donor in Jos, Nigeria.

[10] Elizabeth, C. (2014). Effects of HIV on the body. *Everyday health media, USA. LLC.*

[11] Federal Republic of Nigeria. (2012). Global AIDS response progress report.

[12] Fox, M. (2010). Groups moving forward to develop AIDS gel. *Reuters*. Retrieved on March 29th, 2011.

[13] Gallo, M. F., Kilbourne-Brook, M. & Coffey, P. S. (2012). A review of the effectiveness and acceptability of the female condom for dual protection. *Sexual health* 9 (1): 18–26.. PMID 22348629.

[14] Gilbert, P. B., McKeague, I. W., Eisen, G. Mullins, C., Guéye-Ndiaye, A., Mboup, S. & Kanki, P. J. (2003). Comparison of HIV-1 and HIV-2 infectivity from a prospective cohort study in Senegal. *Statistics in Medicine* 22 (4): 573–593.

[15] Larke, N. (2010). Male circumcision, HIV and sexually transmitted infections: a review. *British journal of nursing* (Mark Allen Publishing) 19 (10): 629–34. PMID 20622758.

[16] Ljubojević, S. & Lipozenčić, J. (2010). Sexually transmitted infections and adolescence. *Acta dermatovenerologica Croatica : ADC* 18 (4): 305–10. PMID 21251451.

[17] Mayor, F. (2012). Major foundation for medical education and research. *Mayor clinic Publication*.

[18] Mark, S. (2000). Debating the Obvious — Page 1 - News — New York. *Village Voice*. Retrieved February 21st, 2012

[19] Mark, S. (2013). Kenya condom advert pulled after religious complaints — Page 1 - News — New York. *BBC*. Retrieved on March 21st, 2013.

[20] Meier, B. M. (2002). International Protection of Persons Undergoing Medical Experimentation: Protecting the Right of Informed Consent, *Berkeley journal of international law* [1085-5718] 20 (3), 513 -554

[21] Ouellet, D. L., Plante, I. & Landry, P. (2008). Identification of functional microRNAs released through asymmetrical processing of HIV-1 TAR element. *Nucleic Acids Res.* 36 (7): 2353–65.

[22] Poku, N. K. and Whiteside, A. (2004) *The Political Economy of AIDS in Africa*.

[23] Reeves, J. D. & Doms, R. W. (2002). Human Immunodeficiency Virus Type 2. *Journal of General Virology*, 83 (6): 1253–65.

[24] Samuel, F. (2009). *HIV and emergencies: one size does not fit all*, London: Overseas Development Institute.

[25] Savelsberg, P. F., Ndonko, F. T. & Schmidt-Ehry B. (2000). Sterilizing vaccines or the politics of the womb: Retrospective study of a rumor in the Cameroon. *Medical Anthropology Quarterly*.

[26] Susan, H. (2003). *Black Death: AIDS in Africa*, Palrave Macmillan.

[27] UNAIDS (2010). Report on the Global AIDS Epidemic. Retrieved on June 8th, 2011.

[28] UNAIDS (2012). The quest for an HIV vaccine.

[29] UNAIDS (2008). Report on the global AIDS epidemic.

[30] UNAIDS (2010). UNAIDS report on the global AIDS epidemic.

[31] UNDP (2011). Human development report.

[32] UNGASS (2010). UNGASS country progress report in Nigeria.

[33] UNICEF (2011). Combating anti-vaccination rumors: Lessons learned from case studies in Africa http://www.path.org/vaccineresources/files/Combating_Antivac_Rumors_UNICEF.pdf.

[34] WHO & UNAIDS (2007). Announce recommendations from expert consultation on male circumcision for HIV prevention. *World Health Organization*.

[35] WHO (2003). Condom Facts and Figures. Retrieved on January 17th, 2006.

[36] WHO/UNAIDS/UNICEF (2011). Global HIV/AIDS response: Epidemic update and health sector progress.

AUTHORS

First Author – Onifade, O. A. (Ph.D.), Department of Health Promotion and Environmental Health Education, Faculty of Education, University of Ilorin, Nigeria

Second Author – Ruth Adio-Moses (Ph.D.), Department of Human Kinetics and Health Education, University of Ibadan

Third Author – Ologele, I. (Ph.D.), Department of Health Promotion and Environmental Health Education, Faculty of Education, University of Ilorin, Nigeria

Fourth Author – Adigun, J. O. (M.Ed.), Department of Health Promotion and Environmental Health Education, Faculty of Education, University of Ilorin, Nigeria, e-mail address: adigunjoseph12@gmail.com

Fifth Author – Ogungboye, R. O. (M.Ed.), Department of Health Promotion and Environmental Health Education, Faculty of Education, University of Ilorin, Nigeria

Sixth Author – Abikoye, A. I. (M.Ed.), Department of Health Promotion and Environmental Health Education, Faculty of Education, University of Ilorin, Nigeria

Seventh Author – Oguntunji, I. O. (M.Ed.), Department of Health Promotion and Environmental Health Education, Faculty of Education, University of Ilorin, Nigeria

Photo-Induced Sodium salt of Partially Carboxymethylated Psyllium-g-Polyacrylonitrile: I. Synthesis and Characterization

Jignesh H. Trivedi^{*}, Wu Min^{**}, Young Huang^{**} and Harikrishna C. Trivedi^{***}

^{*} Post Graduate Department of Chemistry, Sardar Patel University, Vallabh Vidyanagar-388 120, Gujarat State, India

^{**} Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, Beijing, China

^{***} Department of Applied Chemistry, Sardar Vallabhbhai National Institute of Chemistry, Surat-395 007, Gujarat State, India

Abstract- An unreported photo-initiated graft copolymerization of acrylonitrile (AN) onto sodium salt of partially carboxymethylated psyllium (Na-PCMPSy, $DS = 0.13$) was studied using uranyl nitrate (UN) as a photo-initiator. The Optimal reaction conditions for affording maximum percentage of grafting were evaluated by successively varying various reaction parameters viz. concentrations of photo-initiator, nitric acid and monomer as well as reaction time, temperature and amount of substrate. At the optimum reaction conditions the maximum values of the grafting yields achieved were %G = 219.62 and %GE = 99.85. The influence of various reaction parameters on the grafting yields was studied. The reaction mechanism for photo-initiated synthesis of Na-PCMPSy-g-PAN was proposed. The photo-induced grafting copolymerization process was confirmed and the products were characterized by using FTIR, XRD and SEM techniques.

Index Terms- Acrylonitrile, Characterization, Photo-induced Grafting, Sodium salt of Partially Carboxymethylated Psyllium, Uranyl Nitrate

I. INTRODUCTION

The chemical modification of polymeric materials based on natural polysaccharides by grafting has received considerable attention in recent years because of the abundant availability, low cost and ecofriendly nature of the polysaccharides. Among grafting methods used, photo-grafting polymerization is widely known to be useful because of its significant advantages: less degradation of the backbone polymer, control over the grafting reaction in addition to attaining higher grafting efficiency, low cost of operation and selectivity to absorb UV light. Psyllium husk (PSy), whose scientific name is *Plantago ovata*, is a well known natural plant polysaccharide which is used in constipation, diarrhoea, cholesterol control, diabetes and colon cancer (Gupta, 1982). It is found to be a neutral arabinoxylan (arabinose 22.6%, xylose 74.6%, molar basis; only traces of other sugars), the highly branched polysaccharide, consisting of a densely substituted main chain of β -(1 \rightarrow 4)-linked D-xylopyranosyl units to which single units of α -L-arabinofuranose [via α -(1 \rightarrow 3) and/or α -(1 \rightarrow 2) linkages] and additional xylose are attached. Rhamnose, galactose, glucose and rhamnosyluronic acid residues are present as minor constituents (Fischer et al., 2004). Literature survey reveals that PSy has been suitably modified with other materials following grafting methods and used as flocculants (Mishra et al. 2002; Srinivasan et al.; 2002; Mishra et al., 2003; Mishra et al., 2004; Mishra et al., 2002; Mishra et al., 2004; Sen et al., 2012). However, due to the low solubility of PSy in cold water, poor solution clarity as well as the desire for products with modified or special properties, we have carried out carboxymethylation of PSy to obtain sodium salt of partially carboxymethylated psyllium (Na-PCMPSy) and reported first time in the literature the photo-grafting of methyl acrylate (MA) (Trivedi et al., 2009), acrylonitrile (AN) (Dholakia et al., 2011) and butyl acrylate (BA) (Dholakia et al., 2011) as well as methyl methacrylate (MMA) (Dholakia et al., 2012) onto it using ceric ammonium nitrate (CAN) as a photo initiator in an aqueous medium.

In the present study, the results on the evaluation of the optimal reaction conditions in the case of the photo-initiated graft copolymerization of AN onto Na-PCMPSy ($DS = 0.13$) using uranyl nitrate as a photo-initiator in an aqueous medium have been reported. The effects of the reaction conditions on the grafting yields were also studied. FTIR, XRD and SEM techniques were used to characterize the products. However, the studies on the potential application of the synthesized graft copolymer (Na-PCMPSy-g-PAN) as superabsorbent has been carried out successfully and the interesting results regarding the swelling behaviour of the superabsorbent in different swelling media have been obtained and will be published in the following communication.

II. EXPERIMENTAL

2.1. Materials

Psyllium (PSy) was obtained from Sat-Isabgol factory (Unjha, Gujarat India). The methods of preparation and purification, as well as the measurement of degree of substitution (\overline{DS}) of sodium salt of partially carboxymethylated psyllium (Na-PCMPSy) were followed as described earlier (Dholakia et al., 2012). The \overline{DS} of Na-PCMPSy was found to be 0.13. AN (Fluka) was distilled out at atmospheric pressure and the middle fraction was collected and used. Uranyl nitrate (UN, Chiti Chem; Baroda, Gujarat, India) was used as received. Analar grade nitric acid was used. Fresh solutions of the photo-initiator were prepared by dissolving the required amount of UN in nitric acid. All other reagents and solvents used in the present work were of reagent grade. Nitrogen gas was purified by passing through fresh pyrogallol solution. Low conductivity water was used for the preparation of solutions as well as photo-graft copolymerization reactions.

2.2. Photo-graft copolymerization

The photo-graft copolymerization reactions were carried out in a photochemical reactor (Fig. 1) supplied by Scientific Aids and Instrument Corp. (SAIC, Madras, India) as per the procedure described earlier (Thaker and Trivedi, 2005). A weighed amount of Na-PCMPSy ($\overline{DS} = 0.13$, 0.2-1.0 g, dry basis) was dissolved in 144.28 mL of low conductivity water in the reaction flask and the solution was stirred with continuous bubbling of a slow stream of nitrogen gas for one hour at 55°C and thereafter for twenty minutes at room temperature. 2.5 mL of freshly prepared UN solution ($2 \times 10^{-3} - 10 \times 10^{-3}$ mol/L) in nitric acid (nil - 0.5 mol/L) was added to the reaction flask, and the contents were then flushed with purified nitrogen gas which was followed by the addition of freshly distilled AN (0.05-0.308 mol/L). The reaction flask was then assembled with an immersion well containing a 125W medium pressure mercury lamp. The whole assembly (photochemical reactor) was placed in a dark cabinet after covering it completely with aluminum foil. The lamp was then illuminated. Water from a constant-temperature water circulation bath was circulated over the immersion well and the reaction flask. The solution then was irradiated with continuous stirring for different time intervals (0.5-6h) in the temperature range of 20°C -50°C. After the completion of the grafting reaction, the irradiated sample solution was removed carefully, and the crude graft copolymer was isolated by centrifugation. It was then purified by washing with dilute nitric acid and repeated washings with 95% methanol and finally with pure methanol. The crude copolymer sample of Na-PCMPSy-g-PAN thus obtained was dried in vacuum at 40°C. The homopolymer, polyacrylonitrile (PAN), was separated from the crude graft copolymer by carrying out soxhlet extraction with dimethyl formamide for 48h. After the complete removal of the homopolymer, the pure graft copolymer was dried at 40°C in vacuum until a constant weight was obtained.

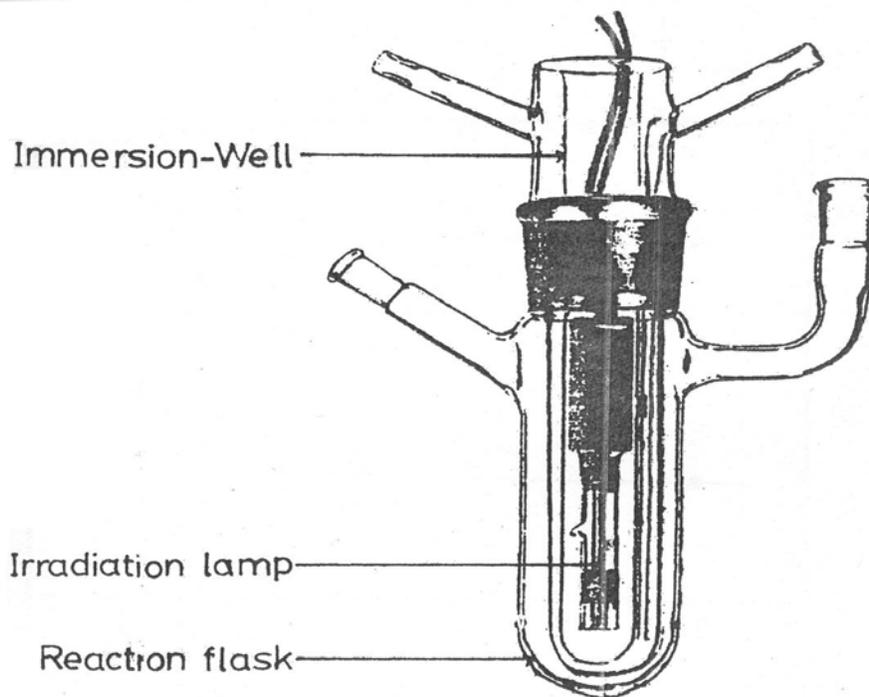


Figure 1: Photo Chemical Reactor

The free radical reaction mechanism of the photo-initiated graft copolymerization of acrylonitrile onto Na-PCMPSy ($\overline{DS} = 0.13$) using uranyl nitrate as a photo initiator is expected to proceed according to the Scheme 1.

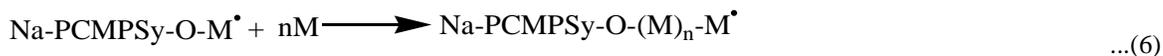
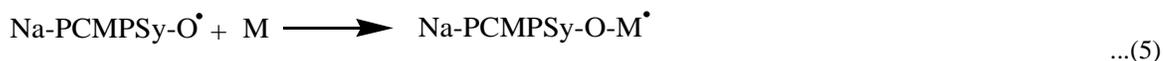
Radical Generation:



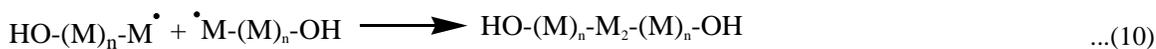
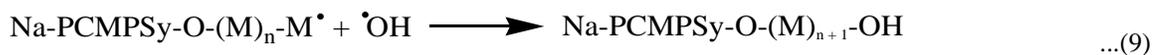
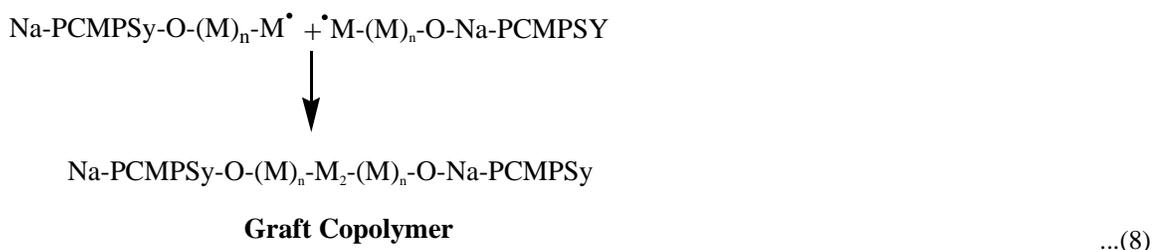
Initiation:



Propagation:



Termination:



Homopolymer

where Na-PCMPSy-O \cdot - Backbone free radical, M \cdot - monomer free radical

Scheme 1: Schematic representation of mechanism for photo-initiated synthesis of Na-PCMPSy-g-PAN

2.3. Grafting Parameters

Grafting parameters viz. percentage of grafting (%G) and percentage of grafting efficiency (%GE) were calculated by using the following expressions (Vora et al., 1995).

$$\% G = \frac{\text{Weight of grafted polymer}}{\text{Initial wight of backbone}} \times 10^2 \quad \dots(11)$$

$$\% GE = \frac{\text{Weight of grafted polymer}}{\text{Weight of grafted polymer} + \text{Weight of homopolymer}} \times 10^2 \quad \dots(12)$$

2.4. Isolation of grafted chains

The graft copolymer of Na-PCMPSy ($\overline{DS} = 0.13$) containing PAN was hydrolyzed by refluxing it for 12h in 1NHCl as described elsewhere (Brockway and Seaberg, 1967) for the isolation of the grafted PAN chains.

2.5. Characterization

2.5.1. Infrared (IR) spectroscopy

IR spectra of PSy, Na-PCMPSy ($\overline{DS} = 0.13$), Na-PCMPSy-g-PAN (%G = 219.62) and PAN were taken in KBr pellets using Excalibur 3100 (varian) spectrophotometer.

2.5.2. X-ray diffraction analysis

X-ray diffraction analysis of PSy, Na-PCMPSy ($\overline{DS} = 0.13$), Na-PCMPSy-g-PAN (%G = 219.62) and PAN was carried out by means of D & Focus (Bruker) powder diffractometer with a Cu K_{α} radiation source.

2.5.3. Scanning electron microscopy (SEM)

Model S-4300 (Hitachi) was used to obtain the micrographs of PSy, Na-PCMPSy ($\overline{DS} = 0.13$) and Na-PCMPSy-g-PAN (%G = 219.62) samples.

III. RESULTS AND DISCUSSION

3.1. Determination of optimum reaction conditions

In the present study of photo-induced graft copolymerization, various reaction conditions were varied to discover those optimum for grafting. The variables studied included amount of the backbone (Na-PCMPSy, $\overline{DS} = 0.13$), concentrations of photo-initiator (UN), nitric acid and monomer (AN) as well as reaction time and temperature.

3.1.1. Effect of backbone concentration

The influence of varying amount of Na-PCMPSy on the grafting yields (%G and %GE) is shown in Fig. 1(a). It can be observed from this figure that the value of %G increases initially with increase in the amount of Na-PCMPSy and reaches a maximum value of 174.50 at 0.5 g of Na-PCMPSy concentration. With a further increase in Na-PCMPSy concentration, %G decreases. However, the value of %GE remains almost constant in the whole range of Na-PCMPSy concentration studied. The initial increase in %G may be due to the fact that the reactive sites increase with increase in amount of Na-PCMPSy. The decrease is attributed to the destruction of radical activity on the backbone soon after it is formed because of termination between backbone-backbone and backbone-primary radicals. Thus, beyond optimum concentration of Na-PCMPSy (0.5 g), the termination rate of photo-graft-copolymerization becomes faster than the rate of initiation leading to the decrease in %G. Similar results are reported in the literature (Dholakia et al., 2011; Shah et al., 1995).

3.1.2. Effect of photo-initiator concentration

Fig. 1(b) shows the effect of the photo-initiator (UN) concentration on the grafting yields. As apparent from the figure, with all other reaction conditions kept constant, the value of %G increases to a maximum value (%G = 203) at $[UN] = 4.15 \times 10^{-3}$ mol/L. However, with further increase in the $[UN]$, the %G decreases. The value of %GE is found to be almost constant in the whole range of photo-initiator concentration range studied. The behaviour with regard to the variation in %G may be explained on the basis of the fact that with increasing the photo-initiator concentration, more Na-PCMPSy macroradicals are generated and consequently more active sites on the Na-PCMPSy backbone could react with AN leading to increasing %G. On the other hand, beyond the optimum concentration of the photo-initiator, there is an abundance of free radicals, which would, terminate the propagation of the graft polymerization leading to a decrease in %G. Moreover, homopolymer formation at higher concentration of the photo-initiator competes with the grafting reaction for the available monomer and could also lead to a decrease in %G. Similar results are also reported in the literature (Trivedi et al., 2009; Dholakia et al., 2012; Thaker M D and Trivedi, 2005; Shukla et al., 1991; Shukla et al., 1992; El-Shrebiny, 2009; El-Shrebiny and Smith, 2010; El-Shrebiny and Smith, 2010).

3.1.3. Effect of acid concentration

The results of the grafting yields (%G and %GE) in the case of photo-grafting of AN onto Na-PCMPSy ($\overline{DS} = 0.13$) at different nitric acid concentrations are depicted in Fig.1(c). It is evident from this figure that there exists an optimum concentration of nitric acid (0.1 mol/L) which affords maximum %G as well as %GE. Beyond the optimum concentration of nitric acid, both the values, %G and %GE are found to be decreased. Interestingly even at zero concentration of nitric acid the value of %G is found to be 134% [cf. Fig. 1(c)] which may be due to the possibility that, even in the absence of acid, in an aqueous medium Na-PCMPSy ionizes fully to a greater extent which facilitates the diffusion of monomer as well as photo-initiator leading to higher value of grafting. Below the optimum concentration the observed increase in the values of %G and %GE with increase in nitric acid concentration may be

attributed to an increase in the initiation rate of photo-grafting. On the other hand, the tendency of grafting yields to decrease with increase in nitric acid concentration, beyond the optimum value (0.1 mol/L), could be associated with a fast rate of termination because of the increased rate of generation of free radical species as well as abundance of hydrogen protons. In addition, coagulation of colloidal homopolymer in solution at lower pH values would also retard diffusion of both monomer and photo-initiator thereby leading to the decreased grafting yields. Similar observations are reported in literature (Trivedi et al., 2009; Dholokia et al., 2012; Thaker and Trivedi, 2005; Trivedi et al., 2015).

3.1.4. Effect of monomer concentration

Fig. 1(d) shows the influence of acrylonitrile concentration on the grafting yields. It can be seen from this figure that in the beginning %G as well as %GE increase rapidly with increasing monomer concentration but beyond AN = 0.1 mol/L, %G increases gradually while %GE remains almost constant. The increase in %G with increasing monomer concentration is probably due to the gel effect i.e. the solubility of polyacrylonitrile in its own monomer and this could be more pronounced at higher monomer concentration. This causes hindrance in termination, particularly by coupling of growing polymer chains. Besides this, the gel effect also causes swelling of Na-PCMPSy, thus facilitating diffusion of monomer to growing grafted chains and the active sites of Na-PCMPSy backbone, thereby enhancing grafting.

However, as it can be seen from Fig. 1(d) that %GE remains almost constant with increasing monomer concentration beyond 0.1 mol/L indicating that even when %G is increased, it has not contributed to a progressive increase in grafting efficiency. This may be due to the fact that the grafted chains acting as diffusion barriers which may impede diffusion of monomer into the backbone leading to the non-availability of the appreciable amount of monomer for photo-grafting. As a result of this there will be correspondingly homopolymer formation besides photo-grafting also, which has a leveling effect in %GE beyond 0.1 mol/L. Similar results are also reported in the literature (Trivedi et al., 2009; Trivedi et al., 2005; Shah et al., 1994).

3.1.5. Effect of reaction temperature

The photo-grafting reactions were carried out at different temperatures between 20°C and 45°C, keeping all other variables constant. Fig. 1(e) represents the influence of temperature on the grafting yields. It can be seen from this figure that in the temperature range 20°C -35°C, there is an increase in the grafting yields with increase in temperature but beyond 35°C they decrease with further increase in temperature. This observed increase in the grafting yields with temperature can be interpreted in terms of the favourable influence of temperature on: (i) the swellability of Na-PCMPSy (ii) the solubility of monomer molecules (iii) the diffusion and mobility of the monomer from the aqueous phase to the Na-PCMPSy backbone and (iv) the rates of initiation and propagation of photo-grafting.

The observed decrease in grafting yields beyond 35°C can be ascribed to the fact that at higher temperature graft copolymerization occurs with poor selectivity. In addition, various hydrogen abstraction and chain transfer reactions also might be accelerated at higher temperature leading to the decrease in the grafting yields. Similar results are also reported in the literature (Dholokia et al., 2011; Dholokia et al., 2011; Shukla et al., 1991; Shukla et al., 1992; Trivedi et al., 2012)

3.1.6. Effect of reaction time

Fig. 1(f) illustrates the effect of reaction time onto the grafting yields. It is interesting to note from this figure that a value of 157% has been obtained for %G in the first half an hour only. However, %G further increases up to a maximum of 197% within 2h. Beyond this optimum time, the value of %G decreases. On the other hand %GE increases up to 2h and then decreases with further increase in time up to 3h, beyond which it remains almost constant. Thus, the observed increase in the grafting yields up to 2h can be explained on the basis of the fact that with increase in reaction time, the number of grafting sites on the Na-PCMPSy backbone increases as a result of which the extent of initiation and propagation of photo-graft copolymerization also increases with reaction time leading to the increase in the grafting yields. On the other hand the observed decrease in %G and %GE, beyond the optimum reaction time, may be presumably due to the detrimental effect of UV radiation onto the grafted side chains of PAN at longer irradiation times in the presence of the photo-initiator. Besides, beyond the optimum reaction time, the depletion of monomer and photo-initiator concentrations as well as shortage of the available grafting sites may lower the grafting yields. Similar results are reported in the literature (Dholokia et al., 2012; Shukla et al., 1991; Shukla et al., 1992; Trivedi et al., 2015).

Thus, from the foregoing discussion, the optimum reaction conditions evaluated for affording maximum percentage of grafting in the case of photo-initiated graft copolymerization of AN onto Na-PCMPSy ($\overline{DS} = 0.13$) are : Na-PCMPSy ($\overline{DS} = 0.13$) = 0.5 g (dry basis), $[UN] = 4.15 \times 10^{-3}$ mol/L, $[HNO_3] = 0.10$ mol/L, $[AN] = 0.222$ mol/L, Temperature = 35°C, Reaction Time = 2h and Total Volume = 150 mL.

At the optimum reaction conditions, the maximum values of the grafting yields achieved were : %G = 219.62 and %GE = 99.85.

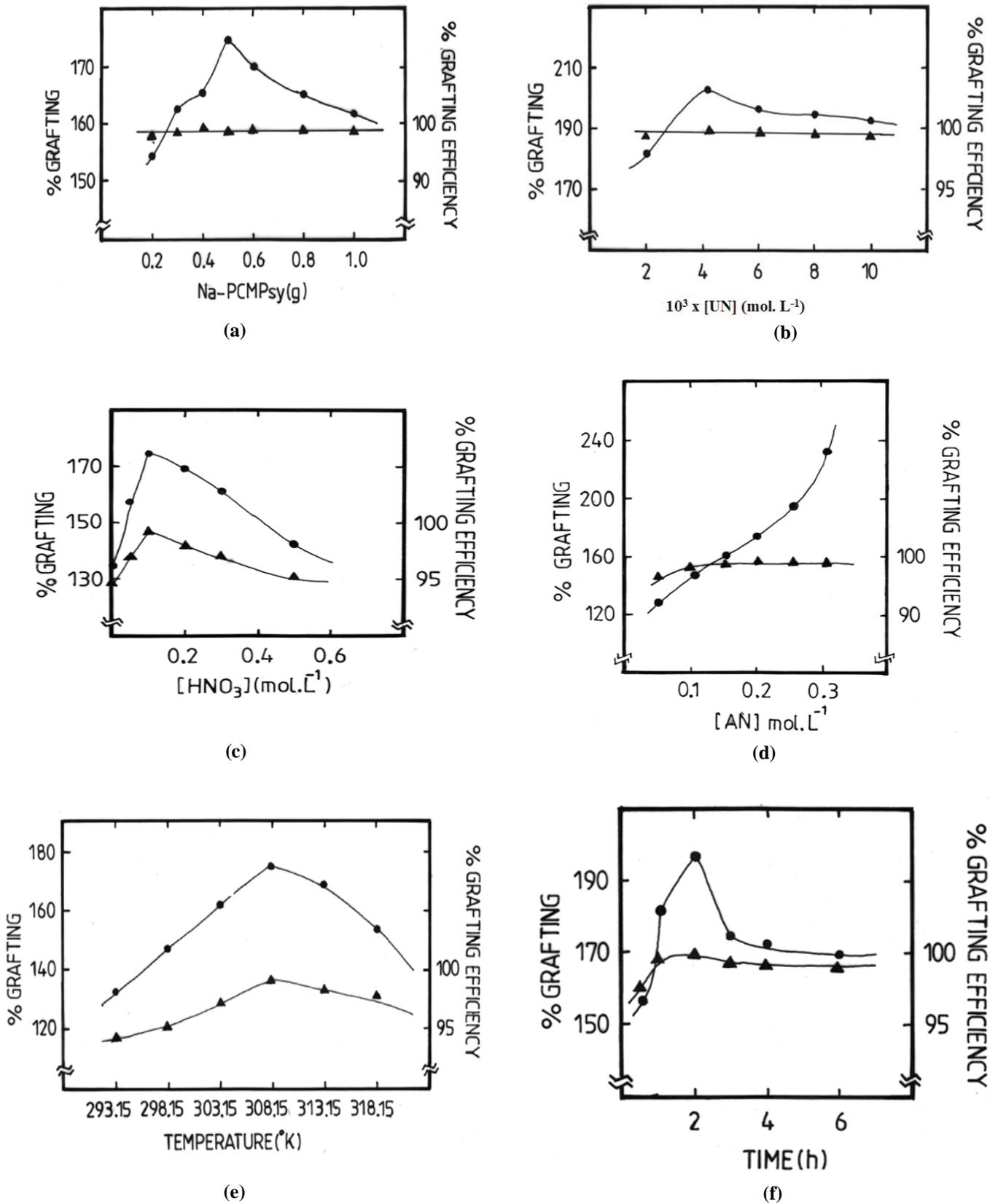


Figure 1. Influence of (a) amount of sodium salt of partially carboxymethylated psyllium; (b) uranyl nitrate (UN) concentration; (c) nitric acid concentration; (d) acrylonitrile (AN) concentration; (e) reaction temperature and (f) reaction time on: (●) - %G; or (▲) - %GE.

IV. CHARACTERIZATION

4.1. FTIR spectroscopy

The IR spectrum of PSy [Fig. 2(a)] shows very strong and broad peak at 3435.2 cm^{-1} which is assigned to the stretching vibration modes of -OH groups. The small peaks at 2924 cm^{-1} and at 1731 cm^{-1} are assigned respectively to the -CH stretching vibrations of CH_2 group and C=O stretching vibrations. The absorption band appeared at 1633.5 cm^{-1} is due to hydration of water. The smaller peaks appeared at 1384.2 cm^{-1} and at 895 cm^{-1} are due to CH , CH_2 as well as OH in-plane bending in carbohydrates and pyranose rings respectively. The band at 1046.7 cm^{-1} is due to the C-O stretching region as complex bands, resulting from C-O and C-O-C stretching vibrations.

Fig. 2(b) represents the IR spectrum of Na-PCMPSy with somewhat reduced intensity of the absorption band at 3421 cm^{-1} , due to OH stretching, indicating that some of the OH groups present in PSy are involved in carboxymethylation. The presence of band at 2925 cm^{-1} is due to -CH stretching. The asymmetric and symmetric vibrations due to -COO- moiety are assigned at 1609.03 cm^{-1} and 1420 cm^{-1} respectively. This can be attributed to the incorporation of carboxymethyl groups in PSy.

Figs. 2(c) and 2(d) show the IR spectra of Na-PCMPSy-g-PAN and PAN (isolated by hydrolysis method) samples respectively. The spectrum of the graft copolymer [Fig. 2(c)] showed absorption bands of Na-PCMPSy ($\overline{\text{DS}} = 0.13$) [Fig. 2(b)] as well as an additional band at $\sim 2244\text{ cm}^{-1}$, which has been attributed to $\text{-C}\equiv\text{N}$ stretching mode, characteristic of the spectra of PAN [Fig. 2(d)]. Thus, the presence of an additional band at $\sim 2244\text{ cm}^{-1}$ in the graft copolymer i.e. Na-PCMPSy-g-PAN indicates beyond doubt that photo-grafting of AN onto Na-PCMPSy ($\overline{\text{DS}} = 0.13$) has taken place. In the IR spectrum of the graft copolymer [Fig. 2(c)] the absorption band appeared at 1449.2 cm^{-1} is attributed to the presence of ether linkage. In comparison with the IR spectrum of Na-PCMPSy ($\overline{\text{DS}} = 0.13$) [Fig. 2(b)], somewhat broad absorption band appeared at 3423 cm^{-1} , due to -OH stretching, in the case of the graft copolymer [cf. Fig. 2(c)] indicating the polymeric association also.

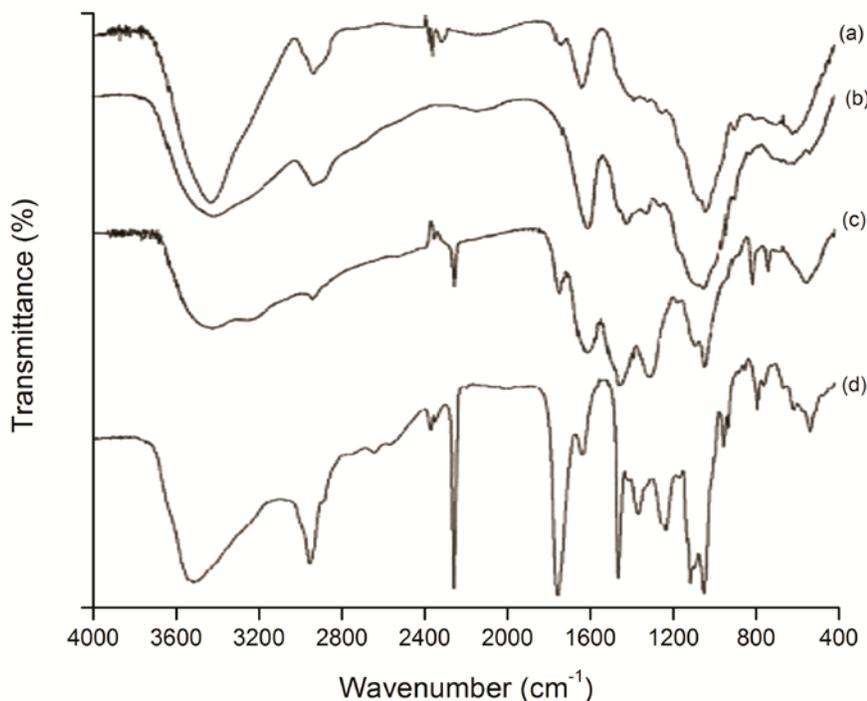


Figure 2: FTIR Spectra of (a) Psyllium (PSy), (b) Na-PCMPSy ($\overline{\text{DS}} = 0.13$), (c) Na-PCMPSy-g-PAN ($\%G = 219.62$) and (d) PAN

4.2. X-ray diffraction analysis

The powder X-ray diffractograms of PSy, Na-PCMPSy ($\overline{\text{DS}} = 0.13$), Na-PCMPSy-g-PAN and PAN are shown in Figs. 3(a) to (d). It can be evident from this figure that the patterns show the complete amorphous nature of PSy and Na-PCMPSy ($\overline{\text{DS}} = 0.13$). In the case of PAN, the crystalline peaks are observed in 2θ range $13\text{-}30^\circ$. The strongest diffraction peak appeared at $2\theta = 16.95^\circ$ and $2\theta = 29.39^\circ$ for PAN are due to the ordered crystal structures made up of PAN linear macromolecules. The XRD pattern of Na-PCMPSy-g-PAN is different from Na-PCMPSy ($\overline{\text{DS}} = 0.13$) and PAN. However, appearance of two weak peaks at $2\theta = 17.29^\circ$ and $2\theta = 28.63^\circ$,

which are very close to the diffraction peak characteristics of PAN (which happened to appear at $2\theta = 16.95^\circ$ and $2\theta = 29.39^\circ$), may be attributed to the occurrence of crystallization of PAN chains to some extent during graft copolymerization.

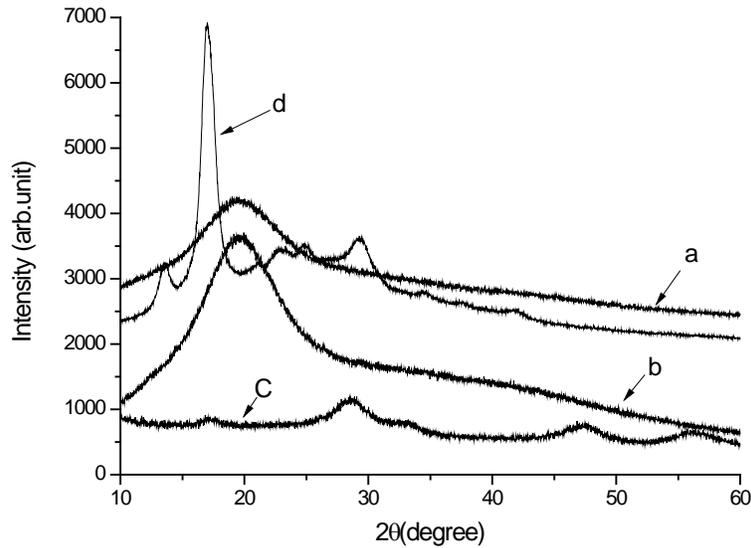


Figure 3: X-Ray diffraction patterns of (a) Psyllium (PSy), (b) Na-PCMPSy ($\overline{DS} = 0.13$), (c) Na-PCMPSy-g-PAN ($\%G = 219.62$) and (d) PAN samples.

4.3. Scanning Electron Microscopy (SEM)

The scanning electron micrograph of psyllium [Fig. 4(a)] shows fiber-like appearance structure. Upon carboxymethylation of psyllium, the structure of psyllium gets improved as shown in Fig. 4(b), wherein the morphology of the fiber-like structure is modified

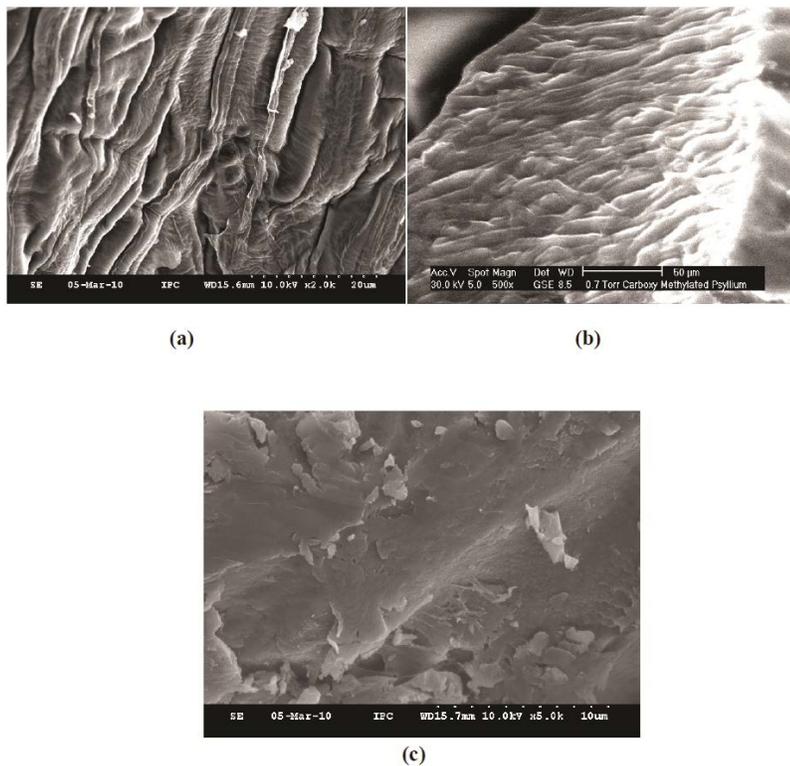


Figure 4: Scanning Electron Micrographs of (a) Psyllium (X 2.0k), (b) Na-PCMPSy ($\overline{DS} = 0.13$) (X500) and (c) Na-PCMPSy-g-PAN ($\%G = 219.62$) (X 5.0k) samples.

in a such a way that because of the introduction of the hydrophilic groups onto psyllium, the fibers seem to have got swollen and exhibited smooth surface. The surface topology of Na-PCMPSy-g-PAN is shown in Fig. 4(c). Upon comparing the morphology of the grafted sample [Fig. 4(c)] with ungrafted material [PSy (Fig. 4(a), Na-PCMPSy (Fig. 4(b))] it is clearly evident that the grafted chains have drastically changed the topology of the Na-PCMPSy ($\overline{DS} = 0.13$) sample. As seen from Fig. 4(c), the stiff morphology with adhering characteristics is observed with AN.

V. CONCLUSION

The optimum reaction conditions for photo-induced graft copolymerization of acrylonitrile onto Na-PCMPSy ($\overline{DS} = 0.13$) have been successfully evaluated using UN as a photo-initiator, and the effects of reaction conditions on grafting yields have been studied. Under the optimized reaction conditions, the maximum values of the grafting yields achieved are: %G = 219.62 and %GE = 99.85. The spectral (infrared), XRD and SEM techniques have been used successfully as the evidence of photo-grafting.

ACKNOWLEDGMENT

One of us (HCT) is grateful to the Chinese Academy of Sciences (CAS) for awarding Visiting Professorship under the Chinese Academy of Sciences Visiting Professorship for Senior International Scientists Programme for carrying out part of this work. Authors are grateful to Prof. Yong Huang and his colleagues for their scientific and technical assistance.

REFERENCES

- [1] Gupta, R. 1982. Recent advances in cultivation of Isabgol (*Plantago ovata* Forsk) in India, in : Atal, C.K., Kapar, B. M. (Eds.), *Cultivation and Utilization of Medicinal Plants*, p.406-417.
- [2] Fischer, M.H., Yu, N., Gray, G.R., Ralph, J., Anderson, L. and Marlet, J.A. 2004. The gel-forming polysaccharide of psyllium husk. *Carbohydr. Res.*, 339(11) : 2009-2017.
- [3] Mishra, A., Srinivasan, R. and Dubey, R. 2002. Flocculation of Textile Wastewater by *Plantago psyllium* Mucilage. *Macromol. Mater. Eng.*, 287(9) : 592-596.
- [4] Srinivasan, R., Agarwal, M. and Mishra, A. 2002. *Plantago psyllium*-Grafted-Polyacrylonitrile — Synthesis, Characterization and Its Use in Suspended and Dissolved Solid Removal from Textile Effluent. *Water Qual. Res. J. Canada*, 37(2) : 371-378.
- [5] Mishra, A., Srinivasan, R. and Gupta, R. 2003. P. *psyllium*-g-polyacrylonitrile: synthesis and characterization. *Colloid Polym. Sci.*, 281(2) : 187-189.
- [6] Mishra, A., Yadav, A., Agarwal, M., Srinivasan, R. 2004. Polyacrylonitrile-grafted *Plantago psyllium* mucilage for the removal of suspended and dissolved solids from tannery effluent. *Colloid. Polym. Sci.*, 282(3) : 300-303.
- [7] Mishra, A., Srinivasan, R., Agarwal, M. and Dubey, R. 2002. P. *psyllium*-g-polyacrylamide: Synthesis and characterization. *Polym. Bull.*, 48(6) : 439-444.
- [8] Mishra, A., Srinivasan, R., Bajpai, M. and Dubey, R. 2004. Use of polyacrylamide-grafted *Plantago psyllium* mucilage as a flocculant for treatment of textile wastewater. *Colloid. Polym. Sci.*, 282(7) : 722-727.
- [9] Sen, G., Mishra, S., Rani, G.U., Rani, P. and Prasad, R. 2012. Microwave initiated synthesis of polyacrylamide grafted *Psyllium* and its application as a flocculant. *Int. J. Biol. Macromol.*, 50(2) : 369-375.
- [10] Trivedi, J.H., Dholakia, A.B., Patel, K.H. and Trivedi, H.C. 2009. Photo-Induced Graft Copolymerization of Methyl Acrylate onto Sodium Salt of Partially Carboxymethylated *Psyllium*. *Trends Carbohydr. Res.*, 1(2) : 38-46.
- [11] Dholakia, A.B., Patel, K.H. and Trivedi, H.C. 2011. Photo-Induced Graft Copolymerization of Acrylonitrile onto Sodium Salt of Partially Carboxymethylated *Psyllium*. *Der Chemica Sinica*, 2(3) : 106-116.
- [12] Dholakia, A.B., Patel, K.H. and Trivedi, H.C. 2011. Graft Copolymerization of butyl acrylate onto sodium salt of partially Carboxymethylated *Psyllium* by Photopolymerization. *Der Chemica Sinica*, 2(6) : 80-88.
- [13] Dholakia, A., Jivani, J., Trivedi, J., Patel, K. and Trivedi, H. 2012. UV-Radiation induced graft copolymerization of methyl methacrylate onto Sodium salt of Partially Carboxymethylated *Psyllium*, *J. Appl. Polym. Sci.*, 124(6) : 4945-4952.
- [14] Thaker, M.D. and Trivedi, H.C. 2005. Ultraviolet-radiation-induced graft copolymerization of methyl acrylate onto the sodium salt of partially carboxymethylated guar gum. *J. Appl. Polym. Sci.*, 97(5) : 1977-1986.
- [15] Vora, R.A., Trivedi, M.C., Patel, C.P. and Trivedi, H. C. 1995. Grafting of acrylonitrile onto styrene-maleic acid copolymer by tetravalent cerium ion. *J. Appl. Polym. Sci.*, 58(9) : 1543- 1550.
- [16] Brockway, C.E., Seaberg, P.A. 1967. Grafting of polyacrylonitrile to granular corn starch. *J. Polym. Sci. Part A-1*, 5(6) : 1313- 1326.
- [17] Shah, S.B., Patel, C.P. and Trivedi, H.C. 1995. Ceric-induced grafting of acrylate monomers onto sodium alginate. *Carbohydr. Polym.*, 26(1) : 61-67.
- [18] Trivedi, J.H.; Thaker, M.D. and Trivedi, H.C. 2015. Photo-Induced Graft Copolymerization of Acrylonitrile onto Sodium Salt of Partially Carboxymethylated Guar Gum. *J. Appl. Polym. Chem.*, 132(5) : 1-10.
- [19] Shukla S.R., Gopala Rao, G.V. and Athalye, A.R. 1991. Photoinitiated graft copolymerization of hydroxyethyl methacrylate onto cotton cellulose. *J. Appl. Polym. Sci.*, 42(8) : 2163-2168.
- [20] Shukla, S.R., Gopala Rao, G.V. and Athalye, A.R. 1992. Ultraviolet-radiation-induced graft copolymerization of styrene and acrylonitrile onto cotton cellulose. *J. Appl. Polym. Sci.*, 45(8) : 1341-1354.
- [21] Trivedi, J.H., Chourasia, A.V. and Trivedi, H. C. 2015. Photo-Induced Synthesis and Characterization of Poly(Methyl Acrylate) Grafted Sodium Salt of Partially Carboxymethylated Sodium Alginate. *Cellulose Chem. Technol.*, 49(1) : 7-19.
- [22] El-Sherbiny, I.M. 2009. Synthesis, characterization and metal uptake capacity of a new carboxymethyl chitosan derivative. *Eur. Polym. J.*, 45(1) : 199-210.
- [23] El-Sherbiny, I.M. and Smyth, H.D.C. 2010. Photo-induced synthesis, characterization and swelling behavior of poly(2-hydroxyethyl methacrylate) grafted carboxymethyl chitosan. *Carbohydr. Polym.*, 81(3) : 652-659.

- [24] El-Sherbiny, I.M. and Smyth, H.D.C. 2010. Poly(ethylene glycol)-carboxymethyl chitosan-based pH-responsive hydrogels: photo-induced synthesis, characterization, swelling, and in vitro evaluation as potential drug carriers. *Carbohydr. Res.*, 345(14) : 2004-2012.
- [25] Trivedi, J.H., Kalia, K., Patel, N.K. and Trivedi, H.C. 2005. Ceric-Induced Grafting of Acrylonitrile onto Sodium salt of Partially Carboxymethylated Guar Gum *Carbohydr. Polym.*, 60 (1) : 117-125.
- [26] Shah, S.B., Patel, C.P. and Trivedi, H.C. 1994. Ceric-induced grafting of ethyl-acrylate onto sodium alginate. *Die Angew. Makromol. Chemie.* 214(1) : 75-89.
- [27] Trivedi, J.H., Jivani, J.R., Patel, K.H. and Trivedi, H.C. 2013. Modification of Sodium salt of Partially Carboxymethylated Tamarind Kernel Powder through Grafting with Acrylonitrile : Synthesis, Characterization and Swelling Behavior. *Chin. J. Polym. Sci.*, 31(12) : 1670-1684.

AUTHORS

First Author – Dr. Jignesh H. Trivedi, M.Sc., Ph.D., Post Graduate Department of Chemistry, Sardar Patel University, Vallabh Vidyanagar-388 120, Gujarat State, India

Second Author – Prof. Wu Min, Ph.D., National Engineering Research Center of Plastics, Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, No 2 Beiyitiao Street, Zhongguancun, Beijing, China

Third Author – Prof. Dr. Yong Huang, Deputy-Director of Technical Institute of Physics & Chemistry, Chinese Academy of Sciences, 2# Beiyitiao, Zhongguancun, Beijing, China)

Fourth Author – Prof. Dr. H.C. Trivedi, Department of Applied Chemistry, Sardar Vallabhbhai National Institute of Chemistry, Surat-395 007, Gujarat State, India

Correspondence Author – Dr. Jignesh H. Trivedi, Post Graduate Department of Chemistry, Sardar Patel University, Vallabh Vidyanagar-388 120, Gujarat State, India, drjignesh2575@yahoo.co.in, Tele: +91-2692-226856 Extn.214, Fax: +91-2692-236475

Photo-induced Sodium salt of Partially Carboxymethylated Psyllium-g-Polyacrylonitrile: II. Synthesis, Characterization and Swelling Behaviour of its Superabsorbent Hydrogel

Jignesh H. Trivedi^{*}, Wu Min^{**}, Young Huang^{**} and Harikrishna C. Trivedi^{***}

^{*} Post Graduate Department of Chemistry, Sardar Patel University, Vallabh Vidyanagar-388 120, Gujarat State, India

^{**} Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, Beijing, China

^{***} Department of Applied Chemistry, Sardar Vallabhbhai National Institute of Chemistry, Surat-395 007, Gujarat State, India

Abstract- Polyacrylonitrile (PAN) grafted sodium salt of partially carboxymethylated psyllium (Na-PCMPSy-g-PAN, %G = 219.62 and %GE = 99.85) was prepared using the established optimized reaction conditions in the case of ultraviolet-radiation induced grafting of acrylonitrile (AN) onto Na-PCMPSy ($\overline{DS} = 0.13$) using uranyl nitrate (UN) as a photo-initiator. The saponification of the graft copolymer, Na-PCMPSy-g-PAN (%G = 219.62), was then performed in 0.7N NaOH solution at 90-95°C to yield a superabsorbent hydrogel, H-Na-PCMPSy-g-PAN. The swelling behaviour of the hydrogel was studied by carrying out its absorbency measurements in low conductivity water, 0.15M salt (NaCl, CaCl₂, AlCl₃) solutions and simulated urine (SU) at different timings. The average salt sensitivity values of the superabsorbent hydrogel were also calculated and compared. The tendency of the absorbency for the hydrogel in salt solutions is found to be in the order Na⁺ > Ca²⁺ > Al³⁺ for NaCl, CaCl₂ and AlCl₃ aqueous salt solutions. The swelling kinetics of the hydrogel in different swelling media was found to obey second order kinetics. The values of the various swelling characteristics of the hydrogel were also reported. FTIR, TGA and SEM techniques were used to characterize the products.

Index Terms- Na-PCMPSy-g-PAN, saponification, superabsorbent hydrogel, swelling kinetics, water absorbency

I. INTRODUCTION

In recent years, increasing interest in natural based and especially polysaccharides based superabsorbent hydrogels has been developed mainly due to high hydrophilicity, biocompatibility, non-toxicity and biodegradability of biopolymers. Superabsorbent hydrogels are hydrophilic, three-dimensional networks and exhibit the ability to highly swell in water, saline, or biological fluids and retain a significant fraction of them within their structure, but they do not dissolve in water (Buchholz and Graham, 1997). Superabsorbent hydrogels are widely used in sanitary goods such as disposable diapers and hygienic napkins. They are also used in soil conditioning and improving water retention capacity of soil in agriculture and horticulture (Po, 1194). Graft copolymerization of vinyl monomers onto polysaccharide backbones followed by crosslinking of their chains is regarded as an efficient method for the synthesis of polysaccharide-based superabsorbent hydrogels (Pourjavadi and Zohuriaan-Mehr, 2002; Shah et al., 1992; Pourjavadi et al., 2007; Wang and Wang, 2010; Mohamadnia et al., 2008; Sadeghi, 2010; Tian et al., 2012; Trivedi et al., 2013).

Psyllium (PSy) is mucilage forming natural polysaccharide, mainly known for its medicinal value (Fischer et al., 2004). The easy availability, low cost and widespread usage makes it a popular and attracted further to explore it for diverse applications. It consists of combination of highly substituted arabinoxylan polysaccharides (Kaith and Kumar, 2007; Izydorczyk and Biliaderis, 1995). These polysaccharides are linear chains of xylose units [β -(1→4)-xylan] to which single units of arabinose and additional xylose are attached. Rhamnose, galactose, glucose and rhamnosyluronic acid residues are present as minor constituents. The physiologically active component of PSy is known to be a highly branched, neutral arabinoxylan.

Literature survey reveals that the psyllium based hydrogels have been used as the drug delivery device (Singh et al., 2006; Singh et al., 2008) for metal ion sorption (Singh et al., 2006) as well as for the absorption of water from different water-oil emulsions (Kaith and Kumar, 2007). Recently, swelling properties of the Psy-g-poly(AA) superabsorbent hydrogels (Kumari et al., 2010; An et al., 2010) have also been reported.

However, due to low solubility of PSy in cold water, poor solution clarity as well as the desire for products with modified or special properties, we have carried out carboxymethylation of PSy to obtain Sodium salt of Partially Carboxymethylated Psyllium (Na-PCMPSy) and reported first time in the literature ultraviolet-radiation induced grafting of various vinyl monomers (Trivedi et al., 2009; Dholakia et al., 2011; Dholakia et al., 2011; Dholakia et al. 2012) onto it using ceric ammonium nitrate (CAN) as a photo-initiator in an aqueous medium.

However, to the best of the authors' knowledge there is no published report regarding the synthesis of a superabsorbent hydrogel via alkaline hydrolysis of the graft copolymer of Na-PCMPSy containing polyacrylonitrile (PAN). Therefore, in the present work, using the established optimized reaction conditions in the case of the ultraviolet-radiation induced graft copolymerization of AN onto Na-PCMPSy ($\overline{DS} = 0.13$) using UN as a photo-initiator, we have synthesized the graft copolymer Na-PCMPSy-g-PAN (%G = 219.62 and %GE = 99.85) and it has been saponified in an alkaline medium to form a superabsorbent hydrogel, H-Na-PCMPSy-g-PAN. The swelling behaviour of the superabsorbent hydrogel, H-PCMPSy-g-PAN, has also been studied in different salt solutions and the swelling kinetics of the hydrogel has been investigated.

I. EXPERIMENTAL

2.1. Materials

Psyllium (PSy) was obtained from Sat-Isabgol Factory (Unjha, Gujarat, India). The methods of preparation and purification, as well as the measurement of degree of substitution (\overline{DS}) of sodium salt of partially carboxymethylated psyllium (Na-PCMPSy) were followed as described and reported earlier (Dholakia et al., 2012). The \overline{DS} of Na-PCMPSy was found to be 0.13. AN (Fluka) was distilled out at an atmospheric pressure and the middle fraction was collected and used. Uranyl nitrate (UN) (Chiti Chem., Baroda, Gujarat, India) was used as received. Analar grade nitric acid was used. Fresh solution of the photo-initiator (UN) was prepared by dissolving the required amount of UN in nitric acid. Sodium hydroxide, Calcium chloride and Magnesium sulphate (all Samir Tech. Chem. Baroda, Gujarat, India) were used as received. Sodium chloride as well as Urea (both Maruti Chemicals Corporation, Anand, Gujarat, India) and Aluminium chloride (Loba Chemicals, Mumbai, India) of analytical reagent grade were used as received. All other reagents and solvents used in the present work were of reagent grade. Nitrogen gas was purified by passing through fresh pyrogallol solution. Low conductivity water was used for the preparation of solutions as well as photo-graft copolymerization reactions.

2.2 Methods

2.2.1. Photo-graft copolymerization

The photo-graft copolymerization reaction was carried out in a photochemical reactor supplied by Scientific Aids and Instrument Corp. (SAIC, Madras, India) as per the procedure described earlier (Thaker and Trivedi, 2005). A weighed amount of Na-PCMPSy ($\overline{DS} = 0.13$, 0.5g, dry basis) was dissolved in 144.28 mL of low conductivity water in the reaction flask and the solution was stirred with continuous bubbling of a slow stream of nitrogen gas for one hour at 55°C and thereafter for twenty minutes at room temperature. 2.5 mL of freshly prepared UN solution (4.15×10^{-3} mol/L) in nitric acid (0.10 mol/L) was added to the reaction flask, and the contents were then flushed with purified nitrogen gas which was followed by the addition of freshly distilled AN (0.222 mol/L). The reaction flask was then assembled with an immersion well containing a 125W medium pressure mercury lamp. The whole assembly (photochemical reactor) was placed in a dark cabinet after covering it completely with aluminum foil. The lamp was then illuminated. Water from a constant-temperature water circulation bath was circulated over the immersion well and the reaction flask. The solution then was irradiated with continuous stirring for 2h at 35°C. After the completion of the grafting reaction, the irradiated sample solution was removed carefully, and the crude graft copolymer was isolated by centrifugation. It was then purified by washing with dilute nitric acid and repeated washings with 95% methanol and finally with pure methanol. The crude copolymer sample of Na-PCMPSy-g-PAN thus obtained was dried in vacuum at 40°C. The homopolymer, polyacrylonitrile (PAN), was separated from the crude graft copolymer by carrying out soxhlet extraction with dimethyl formamide for 48h. After the complete removal of the homopolymer, the pure graft copolymer was dried at 40°C in vacuum until a constant weight was obtained.

2.2.2. Grafting Parameters

Grafting parameters viz. percentage of grafting (%G) and percentage of grafting efficiency (%GE) were calculated by using the following expressions (Vora et al., 1995).

$$\%G = \frac{\text{Weight of grafted polymer}}{\text{Initial weight of backbone}} \times 10^2 \quad \dots(1)$$

$$\%GE = \frac{\text{Weight of grafted polymer}}{\text{Weight of grafted polymer} + \text{Weight of homopolymer}} \times 10^2 \quad \dots(2)$$

2.2.3. Isolation of grafted chains

The graft copolymer of Na-PCMPSy ($\overline{DS} = 0.13$) containing PAN was hydrolyzed by refluxing it for 12h in 1NHCl as described elsewhere (Brockway and Seaberg, 1967) for the isolation of the grafted PAN chains.

2.2.4. Saponification or alkaline hydrolysis

The graft copolymer, Na-PCMPsy-g-PAN (%G = 219.62 and %GE = 99.85) synthesized under optimally reaction conditions was saponified by following the methanol precipitate method (Fanta et al., 1978) for the formulation of the superabsorbent hydrogel, H-Na-PCMPsy-g-PAN. According to this method, in a loosely stoppered 500 mL flask, 10.0 g of the Na-PCMPsy-g-PAN was dispersed in 100 mL 0.7N sodium hydroxide solution and gently stirred in the base under atmospheric conditions (5 mins). Then the dispersion was heated at 90-95°C with occasional stirring. The saponification was continued until the colour of the mixture changed from deep orange-red to light yellow (~2.5 h). The pasty mixture was then allowed to cool to room temperature. Methanol (5 x 10 mL) was added portion-wise to the gelled product while mixing. After 1 h, 200 mL additional methanol was added to the yellow dispersion of the hydrogel (H-Na-PCMPsy-g-PAN) to complete the precipitation. The supernatant was decanted after 30 mins; and 300 mL fresh methanol was then further added to completely de-water the particles for 24h. The yellow precipitate of the hydrogel (H-Na-PCMPsy-g-PAN) was filtered through sintered glass crucible (no. 3) using suction. Thus, the product of the hydrogel, H-Na-PCMPsy-g-PAN obtained was thoroughly washed with fresh methanol and finally dried at 60°C and stored in a vacuum desiccator.

2.2.5. Swelling or absorbency measurements

In order to measure the swelling or absorbency capacity of the hydrogel, 0.1 g of the saponified Na-PCMPsy-g-PAN (i.e. H-Na-PCMPsy-g-PAN) powder, after passing through 100 mesh (150 μ_m) sieve, was put into a weighed tea bag. The tea bag then was immersed in 200 mL low conductivity water and allowed to soak for different timings (0.5 to 24 h) at room temperature. The equilibrated swollen gel was then allowed to drain by removing the tea bag from the water and was hung up until no more drops drained (~10 min). The bag was then weighed to determine the weight of the swollen gel.

By using the swelling or absorbency experimental weights of the hydrogel sample, the values of the Swelling Ratio (S) and the Equilibrium Water Content (EWC%) of the hydrogel sample were calculated using the following equations :

$$S = \frac{W_s - W_d}{W_d} \quad \dots(3)$$

where W_s and W_d are the weights of the swollen gel and the dry gel, respectively. Thus, the swelling ratio (S) was calculated as grams of water per grams of hydrogel sample (g/g gel). The water absorption capacity was determined three repeats for each case and its average value was reported.

$$EWC (\%) = \frac{W_{eq} - W_d}{W_s} \times 100 \quad \dots(4)$$

where W_{eq} is the weight of swollen gel at equilibrium.

2.2.6. Swelling in salt solutions

Absorbency measurements of the H-Na-PCMPsy-g-PAN hydrogel sample were also carried out in 0.15M solutions of NaCl, CaCl₂ and AlCl₃ as well as in Simulated Urine (composition: 0.85 g CaCl₂.2H₂O, 1.14 g MgSO₄.7H₂O, 8.20 g NaCl, 20g urea and 1000 mL low conductivity water) solution (Ziderman and Bleayche, 1986) for different timings (0.5h to 24h) according to the method described above for absorbency measurements in low conductivity water.

2.2.7. Swelling kinetics

The swelling kinetics of the superabsorbent hydrogel, H-Na-PCMPsy-g-PAN, was studied by measuring the equilibrium swelling capacity of the hydrogel in low conductivity water, different salt (NaCl, CaCl₂ and AlCl₃) solutions (0.15M) and simulated urine solution at different time intervals according to the above mentioned method.

2.3. Characterization

2.3.1. Viscosity measurements

The molecular weight of the isolated PAN-side chains was determined from the measurements of intrinsic viscosity, $[\eta]$. The measurements were carried out at 25°C in dimethyl formamide using an Ubbelohde Viscometer.

2.3.2. Infrared (IR) spectroscopy

IR spectra of the Na-PCMPsy ($\overline{DS} = 0.13$), Na-PCMPsy-g-PAN (%G = 219.62) and the superabsorbent hydrogel, H-Na-PCMPsy-g-PAN were taken in KBr pellets using Excalibur 3100 (varian) spectrophotometer.

2.3.3. Thermogravimetric analysis (TGA)

The thermal behaviour of PSy, Na-PCMPsy ($\overline{DS} = 0.13$), Na-PCMPsy-g-PAN (%G = 219.62), PAN and the

superabsorbent hydrogel, H-Na-PCMPSy-g-PAN was examined in an inert atmosphere at a heating rate of 10°C/min with the help of Q-600 (TA) thermogravimetric analyzer.

2.3.4. Scanning electron microscopy (SEM)

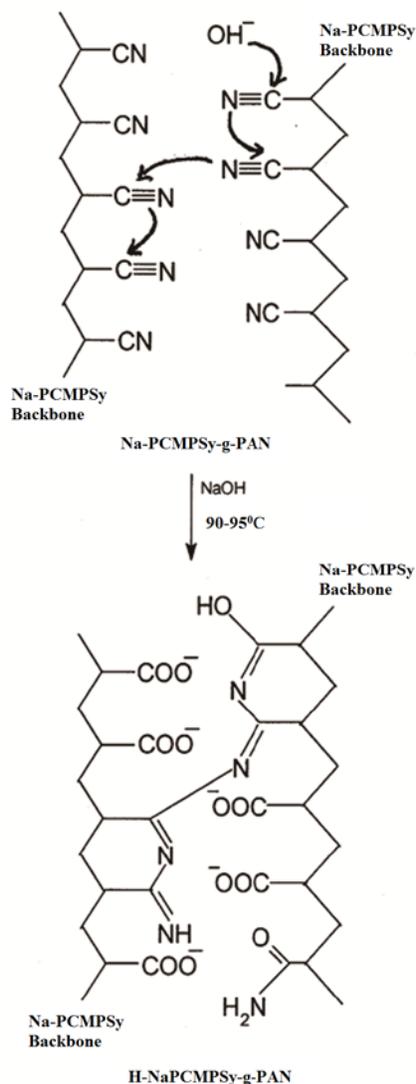
Model S-4300 (Hitachi) was used to obtain the micrographs Na-PCMPSy ($\overline{DS} = 0.13$), Na-PCMPSy-g-PAN (%G = 219.62) and the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN.

III. RESULTS AND DISCUSSIONS

3.1. Superabsorbent hydrogel, H-Na-PCMPSy-g-PAN

3.1.1. Mechanism of hydrogel formation

As discussed above in the experimental section, the saponification of Na-PCMPSy-g-PAN (%G = 219.62) sample was carried out by treating it with aqueous 0.7N sodium hydroxide solution at 90-95°C. Scheme 1 represents the concise mechanism of crosslinking during conversion of nitrile groups of Na-PCMPSy-g-PAN into carboxamide and sodium carboxylate groups for the



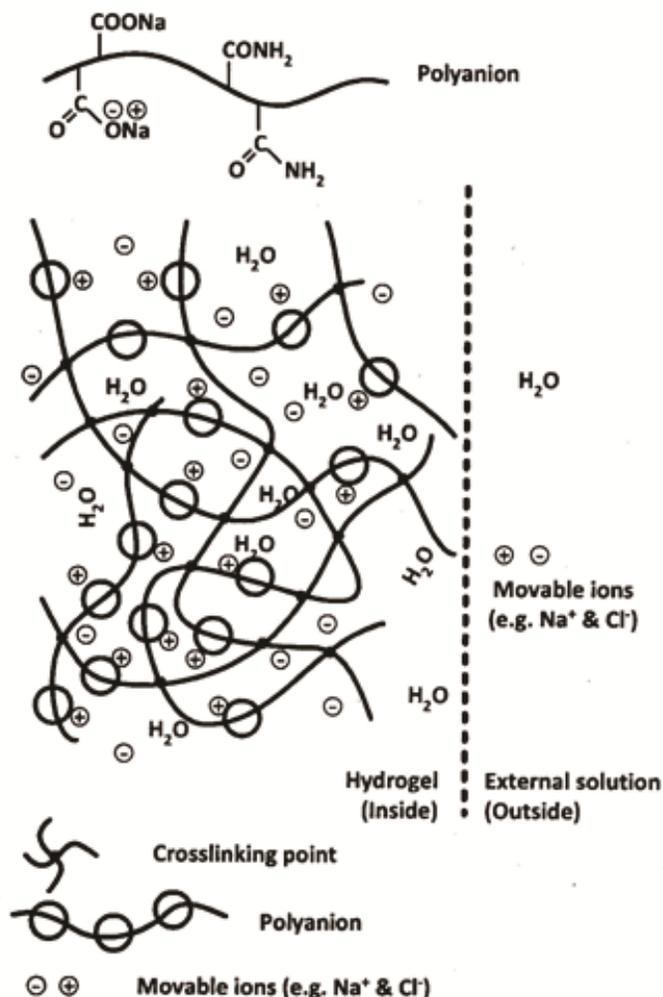
Scheme 1. A concise mechanism for the synthesis of the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN.

formation of the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN. As per the mechanism of the saponification reaction, in the first step the hydroxide ions abstract hydrogen from the -OH group of Na-PCMPSy substrate to the formation of the corresponding alkoxide anions. Then, these Na-PCMPSy alkoxide anions (i.e. macroradicals) initiate cross-linking reaction between some adjacent polyacrylonitrile pendant chains which leads to the formation of deep red colour intermediate with naphthyridine cyclic structures,

including imine, with evolution of ammonia. This intermediate, then further gets saponified with residual sodium hydroxide solution to produce hydrophilic carboxamide and carboxylate groups. The disappearance of the conjugated system with the formation of the hydrophilic groups was indicated when colour of the system changed from red to light yellow. This sharp change in colour was used as a marker to halt the alkaline or saponification treatment. In this way, the starting hydrophobic graft copolymer sample i.e. Na-PCMPsy-g-PAN was converted into a hydrophilic gel i.e. superabsorbent hydrogel, H-Na-PCMPsy-g-PAN. The mechanism depicted in Scheme 1 is in accordance with the literature data (Castel et al., 1990; Savojo and Pourjavadi, 2006)

3.1.2. Swelling behaviour in water and salt solutions

In view of the great impact of external saline solutions on water absorbency of superabsorbents and extending their applications, especially for agriculture, hygienic products, the swelling behaviour of the superabsorbent hydrogel, H-Na-PCMPsy-g-PAN has been studied in low conductivity water as well as different saline solutions. The presence of ions in the swelling medium has a profound effect on the swelling behaviour of the superabsorbent hydrogels. The underlying principle behind the ionic dependence of swelling is well explained by the Donnan Equilibrium theory (Scheme 2). According to this theory, the balance between the osmotic pressure of the swelling system and elastic response of the polymeric network that controls the extent of swelling. The osmotic pressure results from the difference in concentration of mobile ions between the interior of the hydrogel network and the external solution. The fundamental feature within the hydrogel, bringing about the unequal distribution, in the present case, is the presence of the ionizable, carboxylate groups (anionic sites) attached to the polymeric network.



Scheme 2. Representation of swollen anionic superabsorbent hydrogel in equilibrium with electrolyte solution.

In the present work, the swelling behaviour of the “anionic” superabsorbent hydrogel, H-Na-PCMPsy-g-PAN, has been studied by carrying out its absorbency measurements in low conductivity water, 0.15M salt (NaCl , CaCl_2 and AlCl_3) solutions and simulated urine (SU) at different timings. The results obtained are depicted in Fig. 1. The swelling of the anionic hydrogel is found to be increased steadily and continuously with time in low conductivity water up to 8h beyond which it almost levels off. The hydrophilic

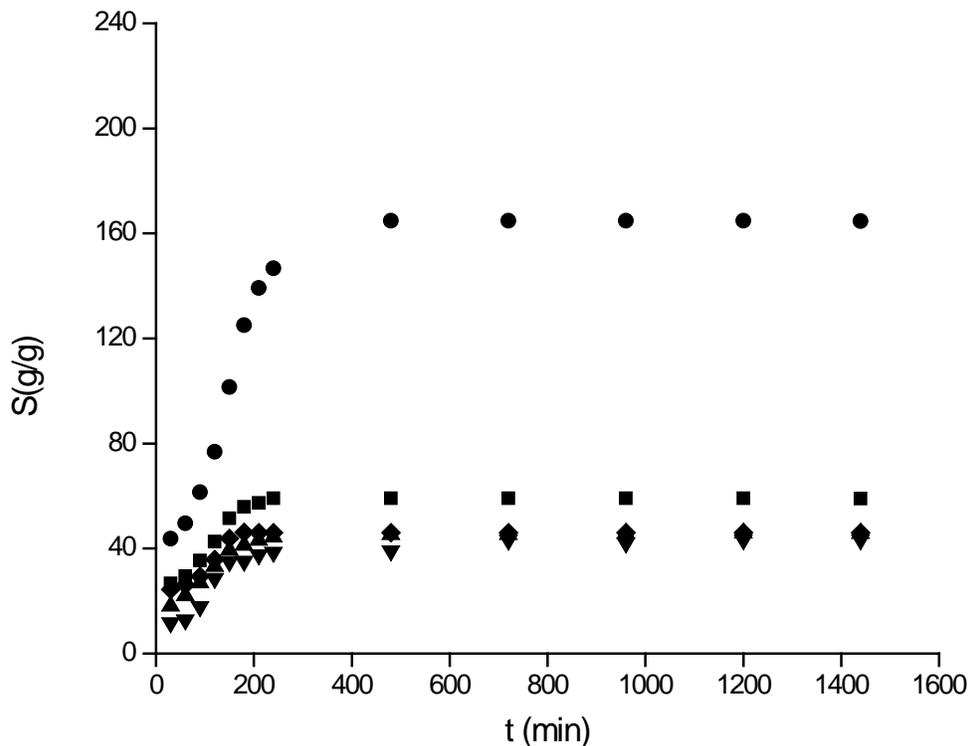
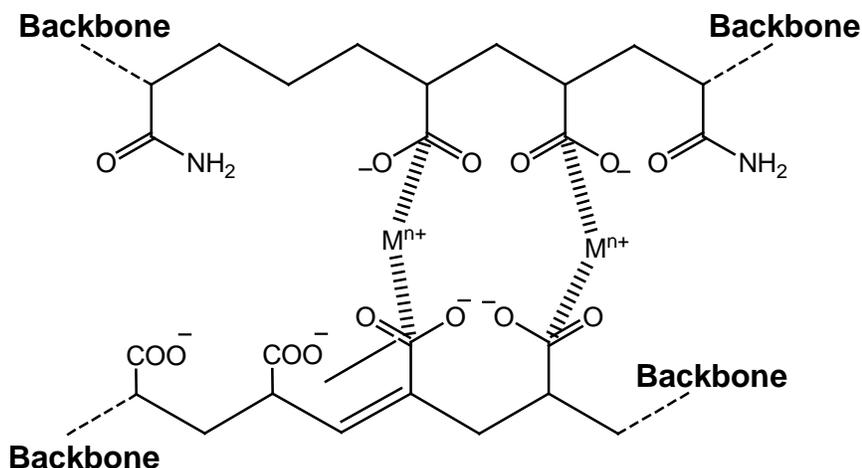


Figure 1. Kinetic swelling curves of the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN in low conductivity water (●), 0.15M NaCl (■), 0.15M CaCl₂ (▲), 0.15M AlCl₃ (▼) and SU (◆).

groups such as carboxylate and carboxamide groups absorb the penetrating water through the formation of hydrogen bonds. The swelling is driven by repulsion of ionic and hydrophilic groups inside the network and osmotic pressure difference between the hydrogel and the external solution. It is also evident from this figure that the hydrogel absorbs water quickly as good swelling (43.67g/g gel) is achieved within half an hour. Therefore, at this point (30 mins), the hydrogel absorbs water with a rate of about 1.46 g/g. min. However, the swelling ability of the anionic hydrogel in different salt (NaCl, CaCl₂ and AlCl₃) solutions, having same concentration (0.15M), as well as in simulated urine (SU) is found to be decreased dramatically at all different timings in comparison with the values measured in low conductivity water (cf. Fig. 1). This well known undesired swelling loss, which is commonly being observed in the swelling of ionic hydrogels (Castel et al., 1990), is attributed to a “charge-screening” effect of the additional counter ions (cations) causing a non-perfect anion-anion electrostatic repulsion (Flory, 1953). The water-absorption properties are thought to result from osmotic pressure and interaction through hydrogen bonding of the carboxylate and carboxamide groups of the polymeric network with water molecules. When low conductivity water is used as swelling agent, the absorption capacity is found to be higher. At the swelling equilibrium, the chemical potential of water in the polymer network will be equal to that of the water surrounding to it. However, when a certain amount of salt (NaCl or CaCl₂ or AlCl₃ or SU, as in the present study) in low conductivity water is used as a swelling agent then the attraction of the strong electrostatic forces exist between the fixed anionic sites or the negatively charged carboxylate groups on the polymer chain and the cations (counter ions) of the salt, as a result of which these cations, by screening the fixed charges on the polymer chain, reduce the electrostatic repulsion tremendously as compared with what it would be in their absence (cf. Fig. 1). Thus, because of the strong electrostatic forces, the concentration of the cations (e.g. Na⁺ or Ca⁺² or Al⁺³) will be higher inside the hydrogel than outside (Scheme 2) as a result of which the osmotic pressure outside the hydrogel will decrease drastically and consequently the absorbency amounts will be diminished (cf. Fig. 1).

The effect of different cations with a common anion (Cl) on the absorbency of the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN can also be explained from the results of Fig. 1. It can be seen from this figure that the absorption capacity of the hydrogel decreases with an increase in the charge of the metal cation (Al³⁺ < Ca²⁺ < Na⁺) in the solutions having the same concentration (0.15M). This can be attributed to the complexing ability arising from the coordination of the multivalent cations with carboxylate groups of the hydrogel to induce the formation of intramolecular and intermolecular complexes (Scheme 3). This leads to an increase in the crosslinking density, which makes network shrink (Pourjavadi and Mahdavinia, 2006). Thus, in the case of AlCl₃, due to the high complexing ability of the Al³⁺ ions with the carboxylate groups of the hydrogel, the crosslink density of the network ultimately



Scheme 3. Ionic crosslinking between a multivalent metal cation and anionic groups of the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN.

increases but it may hinder the approach of the water molecules leading to the lowering of the water uptake compared to that of NaCl (cf. Fig. 1). This ‘ionic crosslinking’ phenomenon mainly occurs at the surface of the particles and as a result, in the present case, the hydrogels are found to be rubbery and very hard to the touch when they swell in Ca^{2+} or Al^{3+} solutions, so that it cannot swell well. In contrast to this, the hydrogel particles are found to be swollen in NaCl and water, exhibiting lower gel strength to the touch. Similar results are also reported in the literature (Zohurian-Mehr and Pourjavadi, 2003; Pourjavadi and Mahdavinia, 2006; Trivedi et al., 2013).

The dimensionless salt sensitivity factor (f) was calculated for 0.15M salt solutions according to the equation (Zohurian-Mehr and Pourjavadi, 2003):

$$f = 1 - (S_{\text{salt}}/S_{\text{water}}) \quad \dots(5)$$

where S_{salt} and S_{water} are the values of the swelling ratio in a given saline solution and low conductivity water, respectively. Thus, the values of f calculated for the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN, in 0.15M different salt solutions and simulated urine at different timings are recorded in Table 1. The influence of increasing cation charge on the ultimate absorption for the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN can be evident upon comparing the average salt sensitivity values (Table 1). It can be seen from this table that due to ionic crosslinking by multivalent cations (Ca^{+2} and Al^{+3}), the average salt sensitivity values of the superabsorbent hydrogel are found to be higher in 0.15M CaCl_2 and AlCl_3 solutions in comparison with univalent cation Na^+ , in 0.15M NaCl solution.

Table 1 Dependency of the dimensionless Salt Sensitivity (f) of the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN to the type of swelling media at different timings.

Time (h)	f_{NaCl}	f_{CaCl_2}	f_{AlCl_3}	f_{SU}	Average Salt Sensitivity ^a
0.5	0.388	0.583	0.732	0.441	
1.0	0.407	0.553	0.740	0.472	
1.5	0.424	0.560	0.709	0.520	
2.0	0.445	0.566	0.627	0.532	$f_{\text{NaCl}} = 0.546$
2.5	0.492	0.611	0.655	0.567	
3.0	0.552	0.669	0.718	0.631	
3.5	0.588	0.689	0.730	0.668	$f_{\text{CaCl}_2} = 0.657$
4.0	0.597	0.697	0.737	0.685	
8.0	0.641	0.725	0.762	0.720	$f_{\text{AlCl}_3} = 0.720$
12.0	0.641	0.724	0.737	0.720	
16.0	0.641	0.722	0.744	0.720	
20.0	0.641	0.721	0.736	0.720	$f_{\text{SU}} = 0.624$
24.0	0.641	0.721	0.737	0.720	

^acalculated as per Eq.(5), on the basis of the Experimental Equilibrium Swelling Ratio (g/g gel) values (Table 2) for different swelling media.

The average salt sensitivity value for the case of simulated urine solution is also found to be higher compared to 0.15M NaCl solution as the solution contains multivalent cations (Mg²⁺ and Ca²⁺) in addition to univalent cation (Na⁺). Thus, lower the cationic charge, the lower will be the average salt sensitivity. In other words, this low average salt sensitivity value is attributed to the low charge screening effect in the hydrogel when the swelling media is 0.15M NaCl solution. Similar results are also reported in the literature (Burugapalli et al., 2001; Mahdavinia et al., 2004).

3.2.3. Swelling kinetics

In order to evaluate the mechanism of the swelling process of hydrogels, several kinetic models are used to test the experimental data. However, in the present work, for evaluating the dynamic swelling properties of the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN, a simple kinetic analysis based on the second order kinetics model was adopted and accordingly the second order equation can be expressed as (Peniche et al., 1997):

$$\frac{dS}{dt} = k_S (S_{eq} - S)^2 \quad \dots(6)$$

where S_{eq}, S and k_S denote the equilibrium swelling (theoretical), swelling at any time, and swelling rate constant respectively. The integration of Equation (6) over the limits S = S₀ at t = t₀ and S=S at t = t, gives

$$t/S = A + Bt \quad \dots(7)$$

where B = 1/S_{eq} is the inverse of the maximum or equilibrium swelling, A = (1/k_S S_{eq}²) is the reciprocal of the initial swelling rate of the hydrogel (r_i), and k_S is the swelling rate constant.

For analyzing the experimental results of the present work in terms of the above kinetic model, the plots of t/S versus t were plotted for the hydrogel, H-Na-PCMPSy-g-PAN in different swelling media. The plots were found to be linear with good correlation coefficient (Table 2), indicating that the swelling behaviour of the hydrogel in the different swelling media follows the pseudo second

Table 2 Swelling Characteristics for the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN, in different swelling media.

Swelling media	Experimental Equilibrium Swelling Ratio (g water/g gel)	^a t _{req} (h)	^b S _{eq} (g water/g gel)	^c EWC (%)	^d r _i [(g water/ g gel)min]	^e k _S x 10 ⁵ [(g gel/g water)/min]	R ²
low conductivity water	164.85	8	200	99.94	1.69	4.22	0.991
NaCl (0.15M)	59.11	4	62.50	99.83	1.78	45.60	0.998
CaCl ₂ (0.15M)	45.30	8	47.62	99.78	1.17	51.80	0.998
AlCl ₃ (0.15M)	43.21	12	47.62	99.77	0.55	24.40	0.994
Simulated Urine (SU)	46.11	3	47.62	99.78	2.04	89.80	0.998

^a Time required to achieve Experimental Equilibrium Swelling Ratio value

^bTheoretical Equilibrium Swelling Ratio

^cEquilibrium water content

^dInitial swelling rate

^eSwelling rate constant

order model. Fig. 2 represents such type of typical plot of t/s versus t obtained for the hydrogel, H-Na-PCMPSy-g-PAN in water as swelling media. The values of the initial rate of swelling (r_i), swelling rate constant (k_S), and theoretical equilibrium swelling (S_{eq}) were calculated from the slope and intersection of the lines obtained in the graphs for the hydrogel, H-Na-PCMPSy-g-PAN in different swelling media and are summarized in Table 2. The values of the Experimental equilibrium swelling ratio for different swelling media are reported in Table 2 along with the corresponding time required to achieve these swelling ratio values. As per Equation (4), the equilibrium water content (EWC%) values were also calculated for the hydrogel in different swelling media and are included in Table 2. It can be further evident from Table 2 that the values of the experimental equilibrium swelling ratios are reasonably in good agreement with those of the theoretical equilibrium ratio (S_{eq}). Mohan et al. have also compared the values of the

experimental equilibrium swelling ratios with the values of the theoretical equilibrium ratio in the case of Semi-IPN hydrogels crosslinked with 1,4-butanediol diacrylate (BDDA) and 1,2-ethyleneglycol dimethacrylate (EGDMA) and their observations are also in line with our observations.

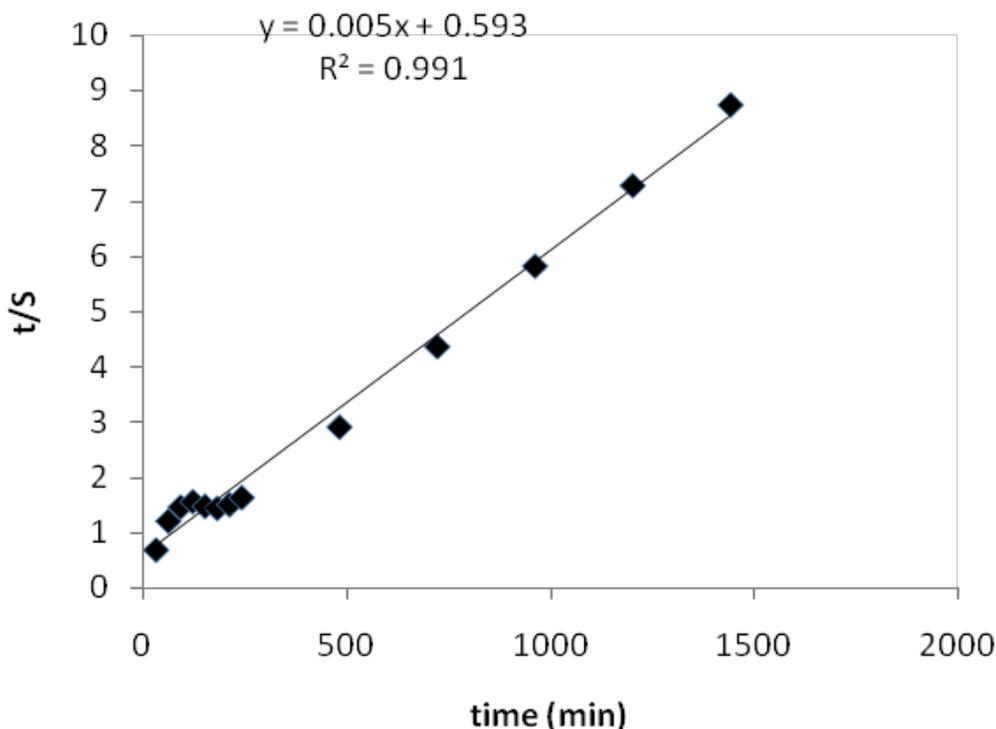


Figure 2. Plot of t/S versus t for the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN in low conductivity water as swelling medium.

IV. CHARACTERIZATION

4.1. Viscosity measurements

The viscosity measurements of the (isolated) polyacrylonitrile (side chains) sample were carried out at 25°C in dimethyl formamide using an Ubbelohde Viscometer in the usual manner. The viscosity-average molecular weight (\overline{M}_v) was calculated from the $[\eta]$ value using the following equation (Rodehed and Ranby, 1986) and it was found to be 2.04×10^4 g/mole.

$$[\eta] = 3.92 \times 10^{-4} \overline{M}_v^{0.75} \text{ dL/g} \quad \dots(8)$$

4.2. FTIR spectroscopy

The spectra of the graft copolymer [Fig. 3(b)] showed absorption bands of Na-PCMPSy ($\overline{DS} = 0.13$) [Fig. 3(a)] as well as an additional band at $\sim 2244 \text{ cm}^{-1}$, which has been attributed to $-\text{C}\equiv\text{N}$ stretching mode indicating that photo-grafting of AN onto Na-PCMPSy ($\overline{DS} = 0.13$) has taken place. Fig. 3(c) represents the IR spectrum of the hydrogel, H-Na-PCMPSy-g-PAN. The disappearance of the nitrile sharp peak at $\sim 2244 \text{ cm}^{-1}$ [cf. Fig. 3 (b)] and appearance of the two distinct bands at $\sim 1578 \text{ cm}^{-1}$ and $\sim 1409 \text{ cm}^{-1}$, indicating the respective presence of C=O asymmetric and symmetric stretching modes of the carboxylate anions and the absorption band appeared at $\sim 1671 \text{ cm}^{-1}$ indicating C=O stretching in carboxamide functional groups are the measure proofs for the conversion of the nitrile groups into carboxamide and carboxylate groups after alkaline hydrolysis of the graft copolymer.

4.3. Thermogravimetric analysis

From the primary thermograms of PSy [Fig. 4(S₁)], Na-PCMPSy ($\overline{DS} = 0.13$) [Fig. 4(S₂)], Na-PCMPSy-g-PAN [Fig. 4(S₃)], the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN [Fig. 4(S₄)] and PAN [Fig. 4(S₅)] samples, obtained at a scan rate of 10°C/min in an inert atmosphere, the temperature characteristic values as well as the decomposition temperature (T_D) values at every 10% weight loss were calculated and recorded for all the samples in Table 3. Upon comparing the char yield (CY) values at 750°C, the following order of decreasing thermal stability is observed:

Na-PCMPSy-g-PAN > H-Na-PCMPSy-g-PAN > Na-PCMPSy > PSy
(CY = 52.54%) (CY = 43.23%) (CY = 30.90%) (CY = 25.86%)

Thus, the observed increase in thermal stability of PSy upon carrying out its carboxymethylation is attributed to the introduction of the polar groups into it leading to the increased inter-and intra-molecular interactions which ultimately imparts higher thermal stability to it.

The thermal stability of the homopolymer, PAN (isolated from the graft copolymer) is found to be higher than the graft copolymer sample. The thermal stability of both grafted and hydrogel grafted copolymers is found to be improved in comparison with Na-PCMPSy itself. The increased ring formation at higher temperatures may be responsible for the observed higher value of the thermal stability, for the Na-PCMPSy-g-PAN compared to Na-PCMPSy (Trivedi et al., 2005). On the other hand, although there is no nitrile group in H-Na-PCMPSy-g-PAN structure, but the existence of COO⁻Na⁺ and CONH₂ groups improve its thermal stability over Na-PCMPSy.

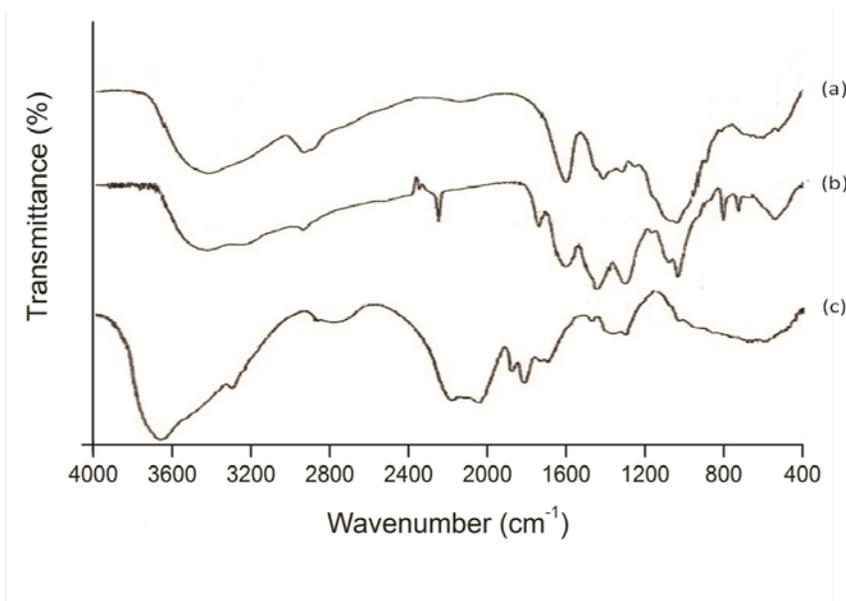


Figure 3. FTIR Spectra of (a) Na-PCMPSy ($\overline{DS} = 0.13$), (b) Na-PCMPSy-g-PAN (%G = 219.62) and (c) the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN.

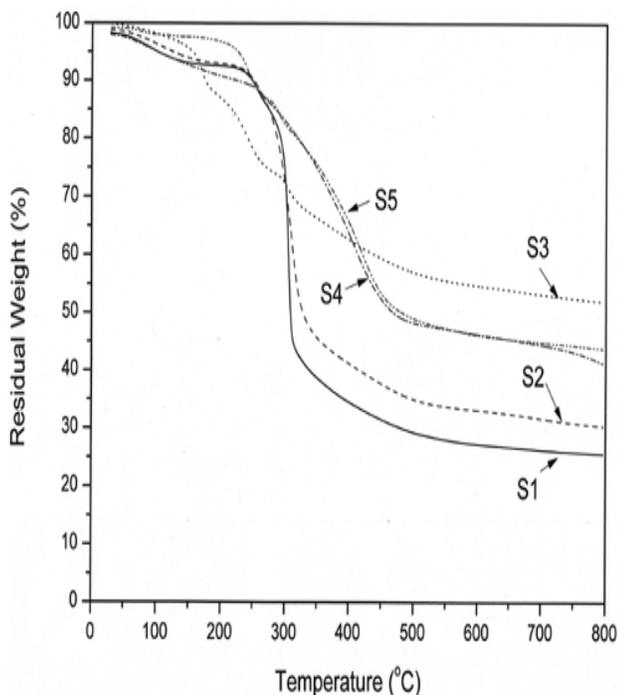


Figure 4. Thermogravimetric curves (TG) for Psyllium (S₁), Na-PCMPSy (DS = 0.13) (S₂), Na-PCMPSy-g-PAN (%G = 219.62) (S₃), H-Na-PCMPSy-g-PAN (S₄) and PAN (S₅) samples in nitrogen atmosphere at a heating rate of 10°C/min.

Table 3 Thermogravimetric analysis of Psyllium (PSy), Na-PCMPSy (DS = 0.13), Na-PCMPSy-g-PAN (%G = 219.62), PAN and the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN samples

Sample	T _i °C (IDT)	T _f °C (FDT)	T _{max} (°C)			Char Yield at 750°C (wt%)	Decomposition temperature (T _D) at every 10% wt. loss (°C)						
			Step-1	Step-2	Step-3		10%	20%	30%	40%	50%	60%	70%
PSy (S ₁)	209	711	305	–	–	25.86	248	292	302	305	308	338	481
Na-PCMPSy (S ₂)	193	771	311	–	–	30.90	251	287	302	312	328	416	796
Na-PCMPSy-g-PAN (S ₃)	117	764	170	241	302	52.54	175	241	311	440	797 ^b	–	–
H-Na-PCMPSy-g-PAN (S ₄)	211	730	264	410	–	43.23	224	319	372	414	469	796 ^c	–
PAN ^a (S ₅)	145	707	242	289	421	44.37	248	317	379	421	482	796 ^d	–

^a $\overline{M}_v = 2.04 \times 10^4$ g/mole ($[\eta] = 3.92 \times 10^4$ dl/g in DMF at 25°C)

^b T_D (°C) value at 48% wt. loss

^c T_D (°C) value at 59% wt. loss

^d T_D (°C) value at 56% wt. loss

4.3. Scanning Electron Microscopy (SEM)

Upon comparing the morphology of the grafted sample [Fig. 5(b)] with ungrafted material [Na-PCMPSy, Fig. 5(a)] it is clearly evident that the grafted chains have drastically changed the topology of the Na-PCMPSy (DS = 0.13) sample. Fig. 5(c) represents the micrograph of the hydrogel, H-Na-PCMPSy-g-PAN. Upon comparing with the morphology of the graft copolymer [cf. Fig. 5(b)], a totally different morphology (porous structure) is observed as the graft copolymer (i.e. Na-PCMPSy-g-PAN) was treated in the alkaline medium to yield the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN [cf. Fig. 5(c)]. It is supposed that these pores are the regions for the penetration of water into the polymeric network, and ultimately it helps in enhancing the water absorbency of the hydrogel.

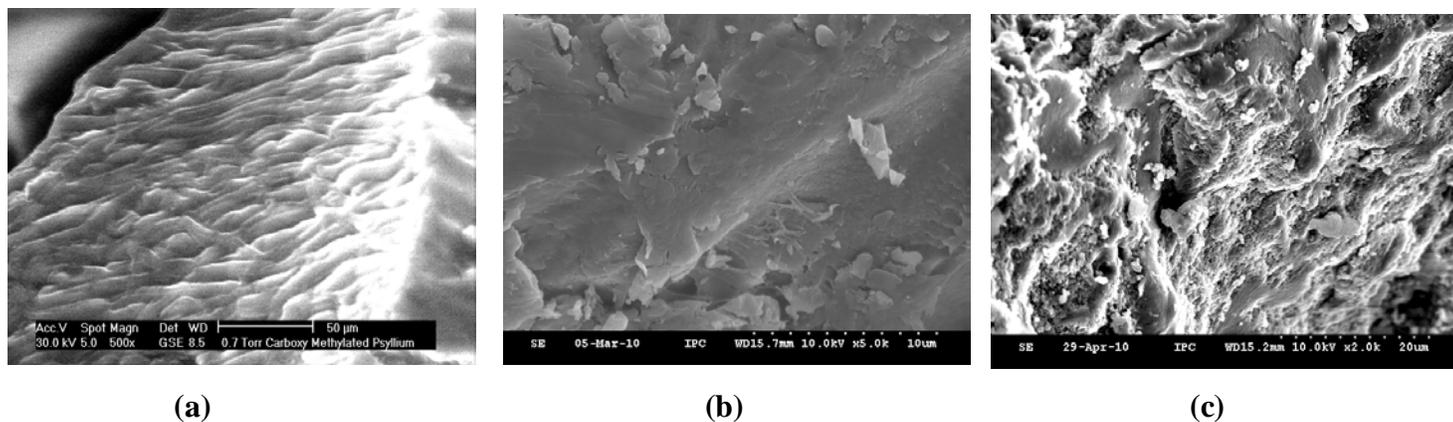


Figure 5. Scanning Electron micrographs of (a) Na-PCMPSy ($DS = 0.13$) (X500), (b) Na-PCMPSy-g-PAN (%G = 219.62) (X 5.0k) and (c) the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN (X 2.0k) samples.

V. CONCLUSIONS

The nitrile groups of Na-PCMPSy-g-PAN (%G = 219.62) were completely converted into a mixture of hydrophilic carboxamide and carboxylate groups during alkaline hydrolysis, followed by in situ crosslinking of the grafted PAN chains in order to synthesize the superabsorbent hydrogel, H-Na-PCMPSy-g-PAN. The swelling behaviour of the synthesized superabsorbent hydrogel was studied in different swelling media and the results regarding its absorbency measurements have been successfully explained on the basis of the “charge screening effect” and “ionic crosslinking” phenomenon. The experimental data suggested clearly that the swelling process of the hydrogel obeys second order kinetics. The observed retention of about 46 g of water by the hydrogel in the presence of simulated urine and that too within 3h is good enough to make the hydrogel as potential candidate for personal health care application. FTIR, XRD, TGA and SEM techniques have been successfully used to characterize all the products.

ACKNOWLEDGMENT

One of us (HCT) is grateful to the Chinese Academy of Sciences (CAS) for awarding Visiting Professorship under the Chinese Academy of Sciences Visiting Professorship for Senior International Scientists Programme for carrying out part of this work. Authors are grateful to Prof. Yong Huang and his colleagues for their scientific and technical assistance.

REFERENCES

- [1] Buchholz, F.L and Graham, A.T. 1997. “Absorbency and Superabsorbency”, in Modern Superabsorbent Polymer Technology, Elsevier, Amsterdam.
- [2] Po, R. 1994. Water-Absorbent Polymers: A Patent Survey. *J. Macromol. Sci. Rev. Macromol. Chem. Phys.*, C34(4) : 607–662.
- [3] Pourjavadi, A. and Zohuriaan-Mehr, M.J. 2002. Modification of Carbohydrate Polymers via Grafting in Air. 1. Ceric-Induced Synthesis of Starch-g-Polyacrylonitrile in Presence and Absence of Oxygen. *Strach/Strake*, 54(3-4) : 140-147.
- [4] Sadeghi, M. 2010. Synthesis and Swelling Behaviors of graft copolymer Based on Chitosan-g-poly(AA-co-HEMA). *Int. J. Chem.Eng. Appl.* 1(4) : 354-358
- [5] Shah, S.B.; Patel, B.K.; Patel, C.P. and Trivedi, H. C. Saponification of Graft Copolymers of Sodium Salt of Partially Carboxymethylated Amylose and Its Water Absorbency. *Starch/Strake*, 44(3) : 108-110.
- [6] Pourjavadi, A.; Zohuriaan-Mehr, M.J.; Ghasempoori, S.N. and Ossienzadeh, H. 2007. Modified CMC. V. Synthesis and super-swelling behavior of hydrolyzed CMC-g-PAN hydrogel. *J. Appl. Polym. Sci.*, 103(2) : 877-883.
- [7] Wang, W. and Wang, A. 2010. Synthesis and swelling properties of pH-sensitive semi-IPN superabsorbent hydrogels based on sodium alginate-g-poly(sodium acrylate) and polyvinylpyrrolidone. *Carbohydr. Polym.*, 80(4) : 1028-1036.
- [8] Mohamadnia, Z.; Zohuriaan-Mehr, M. J.; Kabiri, K. and Nouri-Razavi, M. 2008. Tragacanth gum-graft-polyacrylonitrile: synthesis, characterization and hydrolysis. *J. Polym. Res.*, 15(3) :173-180.
- [9] Tian, D.T.; Li, S.R.; Liu, X.P.; Wang, J.S.; Hu, S.; Liu, C.M. and Xie, H. Q. 2012. Preparation of superabsorbent based on the graft copolymerization of acrylic acid and acrylamide onto konjac glucomannan and its application in the water retention in soils. *J. Appl. Polym. Sci.*, 125(4) : 2748-2754.
- [10] Trivedi, J.H., Jivani, J.R., Patel, K.H. and Trivedi, H.C. 2013. Modification of Sodium salt of Partially Carboxymethylated Tamarind Kernel Powder through Grafting with Acrylonitrile : Synthesis, Characterization and Swelling Behavior. *Chin. J. Polym. Sci.*, 31(12) : 1670-1684.
- [11] Fischer, M.H., Yu, N., Gray, G.R., Ralph, J., Anderson, L. and Marlet, J.A. 2004. The gel-forming polysaccharide of psyllium husk. *Carbohydr. Res.*, 339(11) : 2009-2017.
- [12] Kaith, B.S. and Kumar, K. 2007. In air synthesis of Psy-cl-poly(AAm) network and its application in water-absorption from oil-water emulsions. *EXPRESS Polym. Lett.*, 1(7) : 474-480.
- [13] Izydorczyk, M.S. and Biliaderis, C.G.1995. Cereal arabinoxylans: Advances in structure and physicochemical properties. *Carbohydr. Polym.*, 28(1) :33-48.

- [14] Singh, B.; Chauhan, G.S.; Sharma, D.K.; Kant, A.; Gupta, I. and Chauhan, N. 2006. The release dynamics of model drugs from the psyllium and *N*-hydroxymethylacrylamide based hydrogels. *Int. J. Pharm.*, 325(1-2) : 15-25.
- [15] Singh, B.; Chauhan, N. and Kumar, S. 2008. Radiation crosslinked psyllium and polyacrylic acid based hydrogels for use in colon specific drug delivery. *Carbohydr. Polym.*, 73(3) : 446-455.
- [16] Singh, B.; Chauhan, G.S.; Bhatt, S.S. and Kumar K. 2006. Metal ion sorption and swelling studies of psyllium and acrylic acid based hydrogels. *Carbohydr. Polym.*, 64(1) : 50-56.
- [17] Kaith, B.S. and Kumar K. 2007. Preparation of Psyllium Mucilage and Acrylic Acid Based Hydrogels and their Application in Selective Absorption of Water from Different Oil/Water Emulsions. *Iran. Polym. J.*, 16(8) : 529-538.
- [18] Kumari, A.; Kaith, B.S.; Singha, A.S. and Kalia, S. 2010. Synthesis, characterization and salt resistance swelling behavior of psy-g-poly(AA) hydrogel. *Adv. Mat. Lett.*, 1(2) : 123-128.
- [19] An, J.K.; Wang, W.B. and Wang, A.Q. Preparation and swelling properties of a pH-sensitive superabsorbent hydrogel based on psyllium gum. *Starch/Stärke*, 62(10) : 501-507.
- [20] Trivedi, J.H., Dholakia, A.B., Patel, K.H. and Trivedi, H.C. 2009. Photo-Induced Graft Copolymerization of Methyl Acrylate onto Sodium Salt of Partially Carboxymethylated Psyllium. *Trends Carbohydr. Res.*, 1(2) : 38-46.
- [21] Dholakia, A.B., Patel, K.H. and Trivedi, H.C. 2011. Photo-Induced Graft Copolymerization of Acrylonitrile onto Sodium Salt of Partially Carboxymethylated Psyllium. *Der Chemica Sinica*, 2(3) : 106-116.
- [22] Dholakia, A.B., Patel, K.H. and Trivedi, H.C. 2011. Graft Copolymerization of butyl acrylate onto sodium salt of partially Carboxymethylated Psyllium by Photopolymerization. *Der Chemica Sinica*, 2(6) : 80-88.
- [23] Dholakia, A., Jivani, J., Trivedi, J., Patel, K. and Trivedi, H. 2012. UV-Radiation induced graft copolymerization of methyl methacrylate onto Sodium salt of Partially Carboxymethylated Psyllium, *J. Appl. Polym. Sci.*, 124(6) : 4945-4952.
- [24] Thaker, M.D. and Trivedi, H.C. 2005. Ultraviolet-radiation-induced graft copolymerization of methyl acrylate onto the sodium salt of partially carboxymethylated guar gum. *J. Appl. Polym. Sci.*, 97(5) : 1977-1986.
- [25] Vora, R.A., Trivedi, M.C., Patel, C.P. and Trivedi, H.C. 1995. Grafting of acrylonitrile onto styrene-maleic acid copolymer by tetravalent cerium ion. *J. Appl. Polym. Sci.*, 58(9) : 1543-1550.
- [26] Brockway, C.E. and Seaberg, P.A. 1967. Grafting of polyacrylonitrile to granular corn starch. *J. Polym. Sci. Part A-1*, 5(6): 1313-1326.
- [27] Fanta, G.F.; Burr, R.C.; Doane, W.M. and Russel, C.R. 1978. Absorbent Polymers from Starch and Flour Through Graft Polymerization of Acrylonitrile and Comonomer Mixtures. *Starch/Stärke*, 30(7) : 237-242.
- [28] Ziderman, I.I. and Bleayche, J. 1986. Role of polyacrylate starch copolymer in water sorption. *J. Appl. Polym. Sci.*, 32(7) : 5791-5798.
- [29] Castel, D.; Richard, A. and Audebert, R. 1990. Swelling of anionic and cationic starch-based superabsorbents in water and saline solution. *J. Appl. Polym. Sci.*, 39(1) : 11-29.
- [30] Savoji, M.T. and Pourjavadi A. 2006. Partially hydrolyzed kappa carrageenan-polyacrylonitrile as a novel biopolymer-based superabsorbent hydrogel: Synthesis, characterization, and swelling behaviors. *Polym. Eng. and Sci.*, 46(12) : 1778-1786.
- [31] Flory, P.J. 1953. *Principles of Polymer Chemistry*, Cornell University Press, Ithaca, NY, p. 168.
- [32] Xu, S.; Cao, L.; Wu, R. and Wang, J. 2006, Salt and pH responsive property of a starch-based amphoteric superabsorbent hydrogel with quaternary ammonium and carboxyl groups (II). *J. Appl. Polym.*, 101(3) : 1995-1999.
- [33] Zohuriaan-Mehr, M.J. and Pourjavadi, A. 2003. Superabsorbent Hydrogels from Starch-g-PAN: Effect of Some Reaction Variables on Swelling Behavior, *J. Polym. Mater.*, 20(1) : 113-120.
- [34] Pourjavadi, A. and Mahdavinia, G. R. 2006. Superabsorbency, pH-Sensitivity and Swelling Kinetics of Partially Hydrolyzed Chitosan-g-poly(Acrylamide) Hydrogels *Turk. J. Chem.*, 30 : 595-608.
- [35] Burugapalli, K.; Bhatia, D.; Koul, V. and Choudhary, V. 2001. Interpenetrating polymer networks based on poly(acrylic acid) and gelatin. I: Swelling and thermal behavior. *J. Appl. Polym. Sci.*, 82(1): 217-227.
- [36] Mahdavinia, G.R.; Zohuriaan-Mehr, M.J. and Pourjavadi, A. 2004. Modified Chitosan. III. Superabsorbency, Salt- and pH-Sensitivity of Smart Ampholytic Hydrogels from Chitosan-g-PAN. *Polym. Adv. Technol.*, 15(4): 173-180.
- [37] Peniche, C.; Cohen, M.E.; Vazquez, B.; Roman, J.S. 1997. Water sorption of flexible networks based on 2-hydroxyethyl methacrylate-triethylglycol dimethacrylate copolymers. *Polymer*, 38(24) : 5977-5982.
- [38] Mohan, Y.M.; Murthy, P.S.K.; Sreeramulu, J. and Raju, K.M. 2005. Swelling behavior of semi-interpenetrating polymer network hydrogels composed of poly(vinyl alcohol) and poly(acrylamide-co-sodium methacrylate). *J. Appl. Polym. Sci.*, 98(1) : 302-314.
- [39] Rodehed, C. and Ranby, B. 1986. Structure and molecular properties of saponified starch-graft-polyacrylonitrile. *J. Appl. Polym. Sci.*, 32(1) : 3323-3333.
- [40] Trivedi, J.H., Kalia, K., Patel, N.K. and Trivedi, H.C. 2005. Ceric-Induced Grafting of Acrylonitrile onto Sodium salt of Partially Carboxymethylated Guar Gum *Carbohydr. Polym.*, 60 (1): 117-125.

AUTHORS

First Author – Dr. Jignesh H. Trivedi, M.Sc., Ph.D., Post Graduate Department of Chemistry, Sardar Patel University, Vallabh Vidyanagar-388 120, Gujarat Stae, India

Second Author – Prof. Wu Min, Ph.D., National Engineering Research Center of Plastics, Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, No 2 Beiyitia Street, Zhongguancun, Beijing, China

Third Author – Prof. Dr. Yong Huang, Deputy-Director of Technical Institute of Physics & Chemistry, Chinese Academy of Sciences, 2# Beiyitia, Zhongguancun, Beijing, China)

Fourth Author – Prof. Dr. H.C. Trivedi, Department of Applied Chemistry, Sardar Vallabhbhai National Institute of Chemistry, Surat-395 007, Gujarat State, India

Correspondence Author – Dr. Jignesh H. Trivedi, Post Graduate Department of Chemistry, Sardar Patel University, Vallabh Vidyanagar-388 120, Gujarat State, India, drjignesh2575@yahoo.co.in, Tele: +91-2692-226856 Extn.214, Fax: +91-2692-236475